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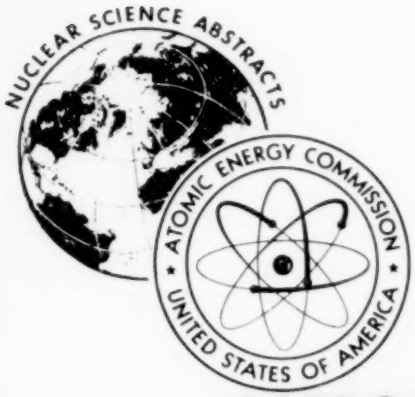

NUCLEAR SCIENCE ABSTRACTS

Volume 17 Number 21
Abstracts 35250–37000

November 15, 1963

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Volume 17, Number 21, November 15, 1963

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Use of funds for printing this publication approved by the Director of the Bureau of the Budget, May 20, 1963.

Volume 17, Number 21 November 15, 1963

NUCLEAR SCIENCE ABSTRACTS

GENERAL AND MISCELLANEOUS

35250 (AD-293918) REPORT ON THE ACTIVITIES OF THE DANISH ATOMIC ENERGY COMMISSION, FOR THE PERIOD FROM APRIL 1, 1961 TO MARCH 31, 1962. (Denmark. Atomenergikommissionen, Roskilde). Oct. 1962. 84p.

The activities of the Danish Atomic Energy Commission for the period April 1961 to March 1962 are described. A general description of the laboratories and research reactors at the Risø Research Establishment is presented. Participation in international atomic energy organizations is also discussed. The technical and administrative organization of the Commission, as well as its expenditures, are outlined. (auth)

35251 (BMI-1632(Del.)) PROGRESS RELATING TO CIVILIAN APPLICATIONS DURING MAY 1963. Russell W. Dayton and Ronald F. Dickerson (Battelle Memorial Inst., Columbus, Ohio). June 1, 1963. Contract W-7405-eng-92. 77p.

Progress is reported on developments relating to civilian applications in reactor materials and components, studies of fuels, fuel element fabrication, radioisotope and radiation applications, tracer systems for in-place filter evaluations, coated-particle fuel materials, corrosion in fluoride-volatility process, USAEC/AECL cooperative program, fission-product deposition studies, irradiation of materials and components, gas-cooled reactor program, fabrication and properties of F-48 niobium alloys, and joining of regenerative cell components. (B.O.G.)

35252 (HW-SA-2841) THE ATOM IN EUROPE. J. C. Tverberg (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Sept. 6, 1962. Contract AT(45-1)-1350. 18p.

Euratom was established to develop nuclear power in the European Community Countries. The operation of Euratom and its research facilities and programs is outlined. The US-Euratom agreement is discussed, and Metallgesellschaft's work on Zr–Nb alloys is described in some detail as an example of the results obtained under a joint US-Euratom contract. The scope of IAEA and other organizations is discussed briefly. The programs of Great Britain, Canada, and European nations for the development of nuclear power are outlined. (D.L.C.)

35253 (IA-775) RESEARCH LABORATORIES SEMI-ANNUAL REPORT, JANUARY–JUNE 1962. (Israel. Atomic Energy Commission, Rehovoth). 189p.

Brief summaries are presented of developments in: utilities operations at IRR-1, radioisotope training center, and radiation hazards protection; research in physics, chemistry, biology and medicine, and environmental studies; and electronics, dosimetry, and nuclear and mechanical instrumentation. A section is included listing reports, and published conference papers, which were issued by the Israel Atomic Energy Commission. (B.O.G.)

35254 (IDO-16898) MATERIALS TESTING REACTOR-ENGINEERING TEST REACTOR TECHNICAL BRANCHES QUARTERLY REPORT, JANUARY 1–MARCH 31, 1963. (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). July 8, 1963. Contract AT(10-1)-205. 58p.

A 32-plate MTR-type fuel element containing 250 g of U^{235} in a U_3O_8-Al dispersion clad with 6061-T6 aluminum operated satisfactorily in the MTR for parts of 5 cycles for an accumulative burnup of 30% of the uranium atoms. An IBM 7090 program, DUZIT, was written to process ARMF-II data. Reactivity measurements were made on natural dysprosium irradiated to 3×10^{21} nvt. The infinite dilution cross section relative to its initial value became approximately stable at 0.27 after 1×10^{21} nvt. Initial loss in resonance integral was 6% per 10^{20} nvt. Calculations of local thermal flux peaking in ETR fuel elements result in more peaking in an element without side plates than in a standard fuel element with side plates. The increase in the water fraction, with side plates eliminated, more than offsets any gain from increasing the fuel-bearing region. As an aid to predicting reactivity effects resulting from changes in the ETR core, four-group, two-dimensional perturbation theory weighting functions were obtained for ETR cycle 47 mock-up in the ETRC. Initial total cross section measurements were made on U^{232}. A mechanical velocity selector is under development for the crystal spectrometer for order discrimination. The ratio of ternary-to-binary fission in U^{235} was measured from 0.025 to 0.45 ev and is found to be constant within 1.5%. Pa^{233} separations at full-concentration levels of Pa^{233} did not yield the same separations obtained using Pa^{231} as a stand-in. New procedures utilizing full concentrations of Pa^{233} are being investigated. Beryllium gas determinations from pieces found in the MTR flash evaporator indicate that the samples were out of the reactor for ≈2.5 years. A series of directional correlation measurements on the high-spin state in Er^{168} were completed. Results of these studies have confirmed the level assignments previously made from decay scheme investigations. Measured mixing ratios for the transitions studied indicate predominately E2 radiation. A study of the decay scheme of Pt^{197} was completed. Certain discrepancies in

previous work were resolved and a consistent level scheme is proposed. Branching ratios for the major gamma rays emitted in the decay of Ba^{140} and La^{140} were measured. This information is necessary to permit the use of these nuclides in the determination of fuel burnup. Tests have indicated that hydraulic shock could have destroyed the pressure transducers used in the Spert I destructive test. It was determined that piezoelectric crystal detectors can be used for pressure measurements in the presence of radiation fields as high as 10^{11} nv peak flux and 10^9 r/hr. A low-pass active filter was designed to give a choice between a maximally flat amplitude response on a maximally flat time-delay response. The cutoff frequency is variable from 39 cps to 10 kc and the rolloff is 36 db/octave. An inexpensive 10-mc white noise source with an output of 0.1 volt rms was developed. An analog computational method of determining the autocorrelation function from the power density spectrum is described. A means of measuring alpha and beta activities simultaneously with a single detector was incorporated in a health physics smear counter. The measurement of the power density spectrum of the statistical neutron variations in the ARMF-II was performed over the frequency range of 0.001 cps to 1 kc. Magnetic tape speed-up factors as high as 16,384 were used successfully for translating low frequencies. The ratio of β/ℓ was calculated to be 110. A fluid column level sampling system capable of measuring the amplitude of oscillation independent of average level was built. The ARMF-II regulating rod servo system employs a torque motor to provide a tachometer signal. A new method for automatic numerical integration was developed, and a FORTRAN program based on the method was written. A FORTRAN subroutine for the solution of the INHOUR equation was completed and checked out. (auth)

35255 (NOLTR-62-191) LIQUID MODEL STUDIES OF THE BASE SURGE. E. Swift, Jr. (Naval Ordnance Lab., White Oak, Md.). Oct. 1, 1962. 22p. (AD-295152)

When a constrained column of dense liquid standing on the bottom of a tank of water is released suddenly, it sinks and flow outward radially along the bottom. This action simulates the early motion of the base surge from shallow underwater explosions. Such liquid model experiments are described, scaling laws are derived, and comparisons with CROSSROADS Baker are made. It is estimated that between 100,000 and 130,000 tons of water in the Baker column contributed to the surge, that the column height was between 3500 and 4000 feet, and that the column density was between 1.4 and 1.6 times that of air. (auth)

35256 (NP-13085) ANNUAL REPORT TO THE DIRECTOR-GENERAL FOR THE YEAR ENDED JUNE 30, 1963. (Australia. Commonwealth X-Ray and Radium Lab., Melbourne). 24p.

A report is presented of the activities of the Commonwealth X-Ray and Radium Laboratory of Australia in radiological physics. These activities include medical applications of x rays and radioactive materials, radiation protection, and other related fields. Tables are presented for the procurement and distribution of radium, radon, and radioisotopes. (D.L.C.)

35257 (ORNL-TM-628) CHEMICAL TECHNOLOGY DIVISION. UNIT OPERATIONS SECTION MONTHLY PROGRESS REPORT, JUNE 1963. M. E. Whatley, P. A. Haas, R. W. Horton, A. D. Ryon, J. C. Suddath, and C. D. Watson (Oak Ridge National Lab., Tenn.). Sept. 12, 1963. Contract W-7405-eng-26. 35p.

An aerosol generator for calibration of a light scattering device to be used to measure particle size distribution and concentration was tested by atomizing latex particles with air. A waste calcination-fixation test (R-76) using Purex FTW-65 type waste with additives to form a phosphate glass was unsuccessful because of solids bridging over and incomplete melting in the calciner vessel. (auth)

35258 (P-2665(RAND)) SOUTHERN CALIFORNIA IN A THERMONUCLEAR WAR. Harold L. Brode (RAND Corp., Santa Monica, Calif.). Nov. 1962. 10p. (AD-290532)

The possibility of survival of residents of Southern California in the event of a thermonuclear war is discussed. The relative hazards from blast, thermal effects, and fallout are considered. The value of shelters in protection of the population is stressed. (C.H.)

35259 (TID-3718) BIBLIOGRAPHIES OF ATOMIC ENERGY LITERATURE. ISSUED OR IN PROGRESS DURING THE PERIOD JUNE–JULY 1963. (Division of Technical Information Extension, AEC). 20p.

An informal supplemental listing is given of 119 unclassified bibliographies, mostly in report form. Subject author, and report number indexes are included. (D.L.C.)

35260 (TID-19135) QUARTERLY PROGRESS REPORT NO. 70 [ON ELECTRONICS]. H. J. Zimmermann and G. G. Harvey (Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics). July 15, 1963. Contract [AT(30-1)-1842]. 381p.

Research programs and developments in the field of electronics, radio physics, plasma dynamics, communication sciences and engineering, and biophysics are reported. Information is given on physical electronics, microwave spectroscopy, far infrared spectroscopy, nuclear magnetic resonance and hyperfine structure, microwave electronics, molecular beams, radio astronomy, physical acoustics, noise in electron devices, electrodynamics of moving media, plasma physics, plasma electronics, plasma magnetohydrodynamics and energy conversion, statistical communication theory, processing and transmission of information, speech communication, mechanical translation, linguistics, advanced computation research, communications biophysics, neurophysiology, neurology, sensory aids research, and stroboscopic research. (N.W.R.)

35261 (TID-19318) ON THE DEVELOPMENT OF KRYPTON-85 AS A UNIVERSAL TRACER. Quarterly Report, May 1, 1963–July 31, 1963. (Parametrics, Inc., Waltham, Mass.). Contract AT(30-1)-2757. 22p.

The sorption of Kr^{85} by carbon, copper, and molecular sieves was studied as a function of pressure up to 48,000 psi. Carbon showed a linear pressure dependency up to 48,000 psi, while for copper, the collected Kr drops off with pressure at $\geq$7500 psi. The structure of molecular sieves broke down at $\geq$5400 psi with a decrease in the collected Kr. Experiments were made on the release of Kr^{85} from CuO at elevated temperatures, and the results indicate a correlation between loss behavior and Kr distribution. Studies were made on possible SO_2 analysis via kryptonates. SO_2-solid kryptonate reactions were found to be too slow, and it was decided to use reaction in solution. Preliminary results of SO_2 analysis in solutions are given. The measurement of physical wear via kryptonates was demonstrated using a kryptonated, electroplated Ni coating on brass. (D.L.C.)

35262 (UCRL-10706) INORGANIC MATERIALS RESEARCH DIVISION ANNUAL REPORT, 1962. (California. Univ., Berkeley. Lawrence Radiation Lab.). Feb. 28, 1963. Contract W-7405-eng-48. 232p.

Development and research at Lawrence Radiation Laboratory on inorganic chemistry, metallurgy, ceramics, and reactor materials engineering are summarized. The three sections of the report are abstracted and indexed for NSA. (N.W.R.)

35263 (UCRL-10706(p.1-110)) CHEMISTRY. (California. Univ., Berkeley. Lawrence Radiation Lab.).

Developments and research in the field of chemistry at Lawrence Radiation Laboratory during 1962 are discussed. Information is presented about inorganic chemistry, chemical thermodynamics, solid-state chemistry and physics, chemical kinetics, and electrochemistry. Topics covered include those on nuclear magnetic resonance, hydrolysis, chromium complexes, chemical reactions, nuclear spin, spectroscopy, superconductivity, phase studies, scattering, molecular and atomic beams, molecular and nuclear structure, electrolysis, and electrode technology. (N.W.R.)

35264 (UCRL-10706(p.111-203)) METALLURGY AND CERAMICS. (California. Univ., Berkeley. Lawrence Radiation Lab.).

Development and research made in metallurgy and for ceramic materials at Lawrence Radiation Laboratory during 1962 are discussed. Information is presented on submicroscopic structure, microstructure, physical properties, kinetics of dislocation mechanisms, high-temperature reactions, and thermodynamics of metals and alloys. (N.W.R.)

35265 (UCRL-10706(p.204-19)) REACTOR MATERIALS ENGINEERING. (California. Univ., Berkeley. Lawrence Radiation Lab.).

The diffusion of xenon-133 in uranium monocarbide at 1000 to 2000°C is theoretically studied. Abstracts are presented of other materials related to reactor engineering on fuel burnup and lifetime, mass transfer in a stirred vessel extractor, diffusion of fission gases in fuels, thermionic cells, and radiation effects in semiconductors. (N.W.R.)

35266 (AWRE-Trans-39) MECHANISM OF FLASHOVER ALONG THE LAYERS OF OIL-PAPER INSULATION IN D.C. SYSTEMS. M. A. Greisukh. Translated by F. E. Wallwork (U.K.A.E.A. Weapons Group. Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.) from Elektrichestvo, [No.] 7, 77-82(1960). 19p.

The effects of insulation thickness, edge structure, voltage polarity, and temperature on the flashover characteristics of oil-paper insulation of the capacitor type for d-c voltages were studied for a wide range of discharge distances. Experimental procedures are described, and the results and conclusions are presented. Values are also given for technical calculations on insulation in structures with shielded plate-edges. (D.C.W.)

35267 THE SIGNIFICANCE OF HEALTH PHYSICS TESTIMONY IN RADIATION INJURY LITIGATION. Edward Forgotson (Univ. of Michigan, Ann Arbor). Health Phys., 9: 741-7(July 1963).

Health physics testimony is an essential item in the handling of a claim involving alleged radiation injury. While radiation is a well-recognized industrial toxic agent, it is confused in the layman's mind with bomb effects. The medical effects of radiation are both latent and non-specific. In many cases, the problem is determining whether the risk of occurrence of a familiar disease was increased by a given radiation exposure. The terminology of health physics creates problems of communication. A defendant should by able, from his records, to determine the maximum credible, and the most probable, radiation dose received by the plaintiff. Proper medical diagnosis should be obtained in every case. Three types of claims—Workmen's Compensation, products liability, and ordinary negligence are discussed. In practice, the burden of proof might actually fall on the defendant because of his superior knowledge and position. Long-term education of the public and courts is most important. (auth)

35268 THE SHAPE OF THE FUTURE. J. Bronowski. Roy. Soc. Health J., 82: 127-30(May-June 1962).

Possible effects of the peaceful uses of nuclear energy on society are discussed. (BBB)

35269 NUCLEAR POWER ECONOMICS. A. Cassuto. World Power Eng., 1: No. 3, 35-6(1962).

The cost of the fuel consumed in a nuclear power reactor is lower than that which is required in conventional power stations for the generation of the same amount of energy: this premise points to the conditions under which atomic energy becomes competitive with conventional thermal power. From the initial $12/lb ($26.4/kg), the incentive price paid to the US mining companies now is down to $8/lb ($17.6/kg), and on 30 July 1962 the UKAEA 12,000 ton Canadian uranium contract for delivery over the next ten years was based on an average price of $5.35/lb ($11.76/kg). Even lower prices are quoted in South Africa, where uranium oxide is obtained cheaply from the waste of the gold mining industry. (TCO)

35270 COMPARISON OF COMMERICAL, SPHERICAL POWDER AND WIRE BUNDLE TUNGSTEN IONIZERS. G. Kuskevics and B. L. Thompson. New York, American Institute of Aeronautics and Astronautics, 1963, Preprint 63016, 45p. (CONF-10-45)

From Electric Propulsion Conference, Colorado Springs, Colo., Mar. 1963.

Cesium ionization on different porous tungsten structures was measured in terms of neutral fraction, critical temperature, and flow rate in a regular laboratory test chamber environment in the 10^{-6} torr range. These structures included $^{3}/_{16}$ in. commerical sintered ionizers with about 2-micron average pore diameter, spherical powder ionizers of 6-micron effective pore diameter and, 12- and 6-micron diameter wire bundle ionizers. Conductance was measured at room temperature with nitrogen and at operating temperature with cesium vapor. The neutral fraction was obtained by a surface ionization probe measurement at 15° to the beam axis. Critical temperatures were derived from the ion current versus ionizer temperature curves. The ion current was measured at a liquid-nitrogen-cooled, grooved current collector which had two grids to suppress secondary electrons. The ionizer temperature was measured with a sheathed tungsten–ruthenium alloy thermocouple. Ion current and neutral fraction were plotted as log j or log α versus 1/T. The directly heated ionizers could be operated up to 1500°C. In general the performance of ionizers improved with time of operation. During this conditioning time the critical temperature and neutral fraction shifted to lower values. The best critical temperatures for all tungsten ionizers in the 10^{-6} torr residual gas pressure at current densities between 1 and 20 ma/cm^2 were within 100°K of Langmuir's data for solid tungsten. Since the surface was not clean the critical temperature had a considerable spread. Neutral fractions for commercial sintered, spherical powder, and fine wire bundle ionizers ranged from 0.1 to 5 percent, but were considerably higher for coarse wire bundle ionizers. (auth)

35271 LONG-TERM DEVELOPMENT OF LOW COST NUCLEAR HEAT AND POWER. Aaron D. Brooks (Dow Chemical Co., Midland, Mich.). 19p. (CONF-15-6)

From American Power Conference Meeting, Chicago, Mar. 1963.

Recoverable fuel reserves and energy demands in the United States and Canada are reviewed. The importance of developing breeder reactors is pointed out, and design criteria for an ideal breeder reactor are presented. Capital and operating costs of an ideal breeder reactor are discussed briefly. (A.G.W.)

BIOLOGY AND MEDICINE

General and Miscellaneous

35272 (BNL-6547) THE USE OF TRITIATED THYMIDINE IN THE STUDY OF TISSUE ACTIVATION DURING GERMINATION IN ZEA MAYS L. O. L. Stein and H. Quastler (Montana State Univ., Missoula and Brookhaven National Lab., Upton, N. Y.). [1962]. Contract AT(45-1)-1302. 18p.

Analysis of incorporation of labeled precursors into DNA coupled with mitotic counts furnishes a picture of the sequence in which tissues become activated during seed germination. By appropriate sampling techniques ontogenetic changes within an organ during germination can be traced and correlated with anatomical information already available. This information will aid in making physiological studies during this phase of plant development more meaningful. In this preliminary study it was found those tissues which mature during embryogeny (root cap, coleorhiza, scutellar node) are first to resume DNA synthesis (30 hr after soaking). No mitoses were observed in these tissues. In shoot and root, mitoses usually precede DNA synthesis, indicating that the nuclei of the dormant embryo have a DNA value of 4C or more. The shoot begins its activity much later than the root (50 hr). The shoot apex was the last region to become active, some 70 hr after initiation of the soaking treatment. (auth)

35273 (BNL-6592) LYSOGENY IN RHIZOBIUM LEGUMINOSARUM AND R. TRIFOLII. E. A. Schwinghamer and D. J. Reinhardt (Brookhaven National Lab., Upton, N. Y. and Australia. Commonwealth Scientific and Industrial Research Organization, Canberra). [1961]. Contract [AT(30-2)-Gen-16]. 20p.

Seven lysogenic bacteria strains, three of Rhizobium leguminosarum and four of R. trifolii, were identified among a total of 54 strains from these two species and R. phaseoli. The R. leguminosarum strains may be multiply lysogenic; two of them also produce lethal agents resembling bacteriocins in their effect. Lysogeny was confirmed by standard criteria of uv-inducibility, self-immunity, and reductive ability. Lysogenic conversion involving symbiotic characteristics was not observed. A minimum of six different temperate phage and two clear-plaque-forming variant phage were identified. The host range includes strains of the above three rhizobial species, but not of R. melilotii. Variation in host specificity of some phage following host passage is under investigation. (auth)

35274 (BNL-6824) EXPERIMENTAL THERMAL AND EPITHERMAL NEUTRON PENETRATIONS IN A PHANTOM HEAD. Ralph G. Fairchild (Brookhaven National Lab., Upton, N. Y.). [1962]. Contract [AT(30-2)-Gen-16]. 26p. (CONF-164-2)

From Society of Nuclear Medicine 10th Annual Meeting, Montreal, June 1963.

The penetration (neutron flux vs distance curve) of a relatively thermal neutron beam was measured in a tissue-equivalent phantom head. The thermalization of the incident beam was varied by changing the thickness of D_2O in its path (Cd ratio of 1/v detector varied between 90 and 180). Penetrations were measured with the incident beam filtered with Cd and Li, and with an unfiltered beam. The epithermal beam resulting when the thermal neutrons were filtered out gave a neutron flux peak at a distance of two to four cm inside the phantom head. Peak flux intensities varied from 1.42×10^{10} n/cm^2/sec to 9.35×10^{10} n/cm^2/sec at a reactor power of 5 Mw. The improved neutron penetration of an epithermal beam (surface to peak ratio of approximately four to one, neutron flux remaining above the entrance value in the region between 0 to 8 cm) will be useful in neutron capture therapy where it is desirable to deliver a neutron dose at depth without destroying surface tissue. (auth)

35275 (BNL-7143) DISTRIBUTION OF TRANSFUSED TRITIATED CYTIDINE LABELED LEUKOCYTES AND RED CELLS IN THE BONE MARROW OF NORMAL AND IRRADIATED RATS. V. P. Bond, L. E. Feinendegen, E. Heinze, and H. Cottier (Brookhaven National Lab., Upton, N. Y.). [nd]. Contract AT-30-2-GEN-16. 23p. (CONF-149-1)

From Conference on Leukopoiesis in Health and Disease, New York, May 1963.

In normal rats and after whole-body irradiation with 550-r x-rays, the fate in the bone marrow of labeled nucleated and red cells of transfused peripheral blood was observed autoradiographically. Labeled nucleated cells, most of which were lymphocyte-like cells, readily migrated into the marrow parenchyma in normal animals (2 cells/1000 parenchymal cells/hr). Following irradiation to at least 27 to 51 hr, this migration appeared to be relatively increased. Beyond this time, parenchymal areas were more difficult to be defined as such. Labeled red cells were rarely observed to enter parenchyma despite the presence of nonlabeled erythrocytes within the parenchymal structure after irradiation. The vascular bed following irradiation increased greatly as the parenchyma diminished to a minimum of less than 10% of control at 75 hr. Despite these changes in the architecture of the marrow, the average density of labeled cells per area of marrow corresponded to values expected on the assumption of a free-flowing circulation. The presently-used technique did not allow distinguishing at all times between a free-flowing circulation through intact sinusoids or through areas in which the sinusoidal wall as such was destroyed. (auth)

35276 (FTD-MT-62-78) PROBLEMS OF SPACE BIOLOGY. N. M. Sisakyan, ed. A Machine Translation of Problemy Kosmicheskoi Biologii, 1: 1-462(1962). 665p.

Volume II Cataloged as JPRS-18395; see NSA 17: 17769.

Separate abstracts were prepared for 10 selected papers on various aspects of the biological effects of radiations encountered during space flight. (C.H.)

35277 (FTD-MT-62-78(p.37-148)) RADIOBIOLOGICAL PROBLEMS OF COSMIC FLIGHTS. A. A. Gyurdzhian. (Translation).

Basic data on cosmic radiation are reviewed. Hazards from cosmic radiation for man during space flights are discussed. (C.H.)

35278 (FTD-MT-62-78(p.250-62)) INFLUENCE OF FACTORS OF SPACE FLIGHT ON IMMUNOLOGIC REACTIVITY OF AN ORGANISM. O. G. Alekseeva and A. P Volkova. (Translation).

Space flight caused moderate changes in immune reactions in dogs, as demonstrated by changes in the normal bacterial flora of the skin and oral cavity. It was concluded

that the changes in immune reactions observed were due to an adaptation reaction to new physical factors accompanying space flights. (C.H.)

35279 (FTD-MT-62-78(p.303-24)) EFFECT OF FACTORS OF COSMIC FLIGHT ON FREQUENCY OF APPEARANCE OF RECESSIVE LETHAL MUTATIONS IN X-CHROMOSOME DROSOPHILA MELANOGASTER. Ya. L. Glembotskii (Glembotskiy), E. A. Abeleva, Yu. A. Lapkin, and G. P. Parfenov. (Translation).

Investigations of two strains of Drosophila melanogaster established a mutagenic effect for the complex of factors encountered during space flight. Lethal mutations were checked cytologically, and 20 were identified as point mutations. It was concluded that these were induced by cosmic radiation. Vibration, acceleration, and weightlessness may influence the genetic effects of radiation during space flight. (C.H.)

35280 (FTD-MT-62-78(p.324-9)) APPEARANCE OF DOMINANT LETHAL MUTATIONS IN DROSOPHILA MELANOGASTER DURING COSMIC FLIGHT ON SHIP-SATELLITE. G. P. Parfenov. (Translation).

A significant increase in frequencies of dominant lethal mutations in spermatides of male Drosophila melanogaster occurred during a satellite flight. Data indicate that the increase was the result of rocket vibrations rather than radiation dose. (C.H.)

35281 (FTD-MT-62-78(p.329-44)) INFLUENCE OF FACTORS OF COSMIC FLIGHT ON HEREDITY AND DEVELOPMENT IN ACTINOMYCETES AND HIGHER PLANTS. Ya. L. Glembotskii (Glembotskiy), A. A. Prokofeva-Belgovskaya, Z. B. Shamina, V. V. Khvostova, S. A. Valeva, N. S. Eyges, and L. V. Nevzgodina. (Translation)

Four strains of Actinomyces were found to be sensitive to conditions encountered during space flight. Viability of radioresistant strains was increased while viability of radiosensitive strains was decreased. The development of seedlings grown from dry seeds of millet, wheat, corn, and peas carried on space flights was studied. Chromosome aberrations were increased in the rootlets of all plants grown from the experimental seeds. Changes in the rate of cell division were also observed in the plant roots. (C.H.)

35282 (FTD-MT-62-78(p.344-9)) INFLUENCE OF CONDITIONS OF COSMIC FLIGHT ON SEEDS OF ALLIUM FISTULOSUM (SPRING ONION) AND NIGELLA DAMASCENA (NUTMEG FLOWER). B. N. Sidorov and N. N. Sokolov. (Translation).

The genetic effects of conditions encountered during space flight were studied in the radiosensitive plant, Allium fistulosum (spring onion), and in the radioresistant plant, Nigella damascena (nutmeg). Space flight had no effect on the frequency of chromosome aberrations or rate of seed germination in either plant. Results suggest that changes observed are due to the influence of the physical conditions encountered during space flight rather than to the effects of cosmic radiation. (C.H.)

35283 (FTD-MT-62-78(p.350-8)) FACTORS OF COSMIC FLIGHT AND PRIMARY NON-DISJUNCTION OF CHROMOSOMES. N. P. Dubinin and O. L. Kanavets. (Translation).

The genetic consequences of non-disjunction of chromosomes are reviewed. Data are presented from an analysis of non-disjunction of sex chromosomes in female Drosophila subjected to space flight. Results are compared with data on female Drosophila exposed to x radiation or to the conditions encountered during space flight with the exception of radiation exposure. Space flight caused more primary non-disjunctions, and the genetic effects were evident for longer periods of time than either of the other conditions tested. (C.H.)

35284 (FTD-MT-62-78(p.358-69)) INFLUENCE OF FACTORS OF COSMIC FLIGHT ON LEVEL [OF] SEROTONIN IN BLOOD OF ANIMALS. V. S. Shashkov, V. V. Antipov, M. O. Raushenbakh, G. A. Chernov, and V. A. Maslennikova. (Translation).

The role of serotonin in the regulation of physiological processes and its role as a radioprotective agent are reviewed. The effects of space flight on the serotonin content of blood were studied in mice and dogs. The level of blood serotonin in both animals was reduced following space flight but returned to normal after 48 hr. The effects of acceleration, vibration, and radiation on blood serotonin content were studied in mice and guinea pigs on the ground. Vibration caused a lowering of blood serotonin levels similar to those observed after space flight. (C.H.)

35285 (FTD-MT-62-78(p.369-72)) DETERMINATION OF INDUCED RADIOACTIVITY IN SECOND SATELLITE SPACE SHIP. V. V. Matveev and A. D. Sokolov. (Translation).

An attempt was made to measure the residual γ activity in biological materials resulting from exposure to cosmic radiation during space flight. A γ spectrometer was used to determine absolute activity and isotopic composition from the spectra of γ radiation. Results showed very low levels of residual γ activity induced in biological materials by radiations encountered during space flights. (C.H.)

35286 (FTD-MT-62-78(p.564-75)) CONCERNING THE QUESTION OF BIOLOGIC ACTION OF COSMIC AND SOLAR RADIATION IN MOUNTAINS. V. I. Danileĭko. (Translation).

Results are summarized from studies of the effects of altitudes up to 3900 m on graying of the hair and erythrocyte, leukocyte, and hemoglobin content of blood in mice and men. It was concluded that the increase in hair graying and erythrocyte number observed was the result of exposure to cosmic radiation. (C.H.)

35287 (HW-76000) HANFORD BIOLOGY RESEARCH ANNUAL REPORT FOR 1962. H. A. Kornberg and E. G. Swezea, eds. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Jan. 15, 1963. Contract AT(45-1)-1350. 282p.

Separate abstracts were prepared on 43 papers included in this report. (C.H.)

35288 (HW-76000(p.1-10)) COMPARATIVE TOXICITY OF Sr^{90}, Ra^{226}, AND Pu^{239}. R. O. McClellan, W. J. Clarke, Glenda S. Vogt, and L. K. Bustad (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Male miniature swine, which received a single intravenous injection of Sr^{90}, Ra^{226}, or Pu^{239} 18 months previously when six weeks, six months, or one year of age, were killed to study the early effects of these radionuclides. Only minimal radiographic changes were observed. Severe histological changes characterized principally by disorganization of developing bone and necrosis and fibrosis were observed in each of the age groups with all three radionuclides. On the basis of histological changes in bone, Pu^{239} in swine, irrespective of age, is more damaging per rad than Ra^{226} or Sr^{90}. Three females injected intravenously with Ra^{226} at three to four years of age all developed clinical symptoms of severe renal damage and succumbed seven to nine months after injection. (auth)

35289 (HW-76000(p.11-17)) COMPARATIVE TOXICITY OF Pu^{239} AND Pu^{238}. J. E. Ballou (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

On an equivalent microcurie basis, Pu^{239} was significantly more toxic than Pu^{238} when administered intravenously to rats as the citrate over a dose range of approximately 80 to 140 μC/kg. Toxicity was demonstrated by an abrupt loss of weight and early death following Pu^{239} injection. The greater toxicity of Pu^{239} was not apparent when lower doses of the isotope were combined with x-ray exposure. It is probable that tissue distribution changes associated with the large mass quantities of Pu^{239} contribute to the acute toxicity of this isotope. (auth)

35290 (HW-76000(p.18-21)) EXCRETION OF PLUTONIUM INTO THE PERFUSED RAT INTESTINE. J. E. Ballou (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Plutonium is excreted into the duodenum to a greater extent than into other segments of the small intestine. Following diethylenetriaminepentaacetic acid treatment, Pu increased 20-fold in the duodenum compared to relatively small increases in the remainder of the small intestine. The significance of bile as a source of Pu in the duodenum is discussed. (auth)

35291 (HW-76000(p.22-30)) METABOLISM AND TOXICITY OF Np^{237} IN THE RAT. D. D. Mahlum, J. E. Ballou, A. C. Case, W. E. Keder, and W. J. Clarke (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Intestinal absorption of Np was influenced by valence state and mass level. Under all circumstances its absorption was substantially greater than that of Pu. The level of Np^{237} deposited in femur and adrenal remained fairly constant over a 207-day retention period. The significance of zonal deposition of Np in the adrenal is discussed as it may relate to critical organ consideration. Female rats receiving 12 or 24 mg Np^{237}/kg died or were moribund within 48 hours. Histological examination revealed damage to the liver, kidney, spleen, and brain. Chemical analysis showed a marked increase in liver lipids. (auth)

35292 (HW-76000(p.31-5)) ACUTE TOXICITY OF Np^{237} AND ITS RELATIONSHIP TO LIVER FUNCTION IN SHEEP. H. W. Casey, R. O. McClellan, W. J. Clarke, and L. K. Bustad (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Deaths with lesions resembling heavy metal poisoning were observed in all sheep intravenously administered 12 mg of Np^{237}/kg body weight and in four out of five animals that received 6 mg/kg. Liver function was impaired in animals that received doses as low as 1.5 mg (1 μC)/kg body weight. (auth)

35293 (HW-76000(p.36-8)) INTERCELLULAR BINDING OF NEPTUNIUM AND PLUTONIUM. D. D. Mahlum (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

The distribution of intravenously administered Np^{237} and Pu^{239} in subcellular fractions of liver and kidney of the rat was found to vary with the tissue studied, the element used, and the chemical form of the element administered. (auth)

35294 (HW-76000(p.39-44)) METABOLISM OF Pm^{147} AND Ce^{144} IN MINIATURE SWINE. R. O. McClellan (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Miniature swine retained approximately 80% of intravenously administered doses of Pm^{147} and Ce^{144} 10 days after administration. Similar tissue distributions were observed for both nuclides, with the majority of the administered dose being found in liver and skeleton. Concentrations of both radionuclides varied by a factor of 4 to 6 for different parts of the skeleton. (auth)

35295 (HW-76000(p.45-55)) BIOLOGICAL EFFECTS OF RADIOIODINE IN SHEEP AND SWINE. L. K. Bustad, V. G. Horstman, E. E. Elefson, D. H. Wood, H. A. Ragan, S. Marks, and W. J. Clarke (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Reproductive studies being performed on animals fed single oral doses of 3 mC of I^{131} in 1957 and 1958 indicate the estrus cycle is not greatly disturbed in the presence of hypothyroidism. Good correlation was obtained between serum protein-bound iodine (PBI), I^{131} uptake following a tracer dose, and the gross manifestations of hypothyroidism. In studies on thyroid uptake of radioiodine following various routes of administration, it was shown that the maximum percent uptake was similar following intravenous, subcutaneous, and oral administration. There was also significant uptake following topical application, and I^{125} and I^{131} proved to be useful as a double tracer in sheep. A thyroid carcinoma was observed in an animal fed 1.5 μC I^{131}/day since 1955, a thyroid adenoma in one ewe given a 3-mC single oral dose four years ago and in a ewe fed 1.5 μC/day during its lifetime of seven years. The Palouse swine fed 5 μC/day since 1957, together with their controls, were autopsied. The mean thyroid weights of the swine fed 5 μC/day were less than one-half that of the controls. The thyroids of the 5-μC group were subjected to a radiation dose greater than 15,000 rads. (auth)

35296 (HW-76000(p.56-9)) AUTORADIOGRAPHIC EVALUATION OF THYROID UPTAKE OF I^{125} IN LAMBS. A. Noyan, N. L. Dockum, and L. K. Bustad (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Autoradiographs of lambs' thyroids at 5 min following intravenous administration of I^{125} showed increased grain density chiefly over the interfollicular tissue. After 15, 30, and 60 min, a progressive increase in emulsion grain registration over colloidal areas was noted in Bouin's fixed tissue but was inconsistent following formalin fixation. (auth)

35297 (HW-76000(p.60-2)) I^{131} IN THE THYROID OF SHEEP AND IN FOOD, THYROID, AND MILK OF DAIRY COWS. L. K. Bustad, E. E. Elefson, E. C. Watson, D. H. Wood, and H. A. Ragan (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

A single I^{131} contamination event (involving forage) was simulated by feeding sheep and dairy cattle I^{131}-labeled feed twice daily, each feed sample being spiked on day one with 5 μC per sample. Peak milk concentration in the dairy cattle occurred on the fourth day with about 0.4% of the first day's dose of 10 μC observed per liter of milk. The peak thyroid concentrations in the sheep and cattle occurred after one week and were 200 and 60% of the first day's dose of I^{131}, respectively. If a person drank one liter of the contaminated milk each day and assuming a 72-hr delay, a 30% uptake and a 7.6-day effective half life, peak thyroid concentrations would have occurred after two weeks at 0.4% of the first day's dose to the cow. The infinity thyroid dose to such a person would be about 700 mrad. (auth)

35298 (HW-76000(p.63-5)) RADIOIODINE IN THYROIDS OF NORTH AMERICAN CERVIDAE. W. C. Hanson (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Iodine-131 concentrations in thyroids of deer from Washington, Colorado, and Maryland and of caribou from Alaska were measured following the resumption of nuclear

weapons tests by the USSR on September 1, 1961. Maximum concentrations occurred nearly two months after the first nuclear test and then decreased at an effective half time of about 15 days. Washington and Colorado deer thyroids contained the highest concentrations, Maryland thyroids were median, and Alaskan caribou thyroids contained lowest concentrations. (auth)

35299 (HW-76000(p.66-83)) BIOLOGICAL EFFECTS OF Sr^{90} IN MINIATURE SWINE. THIRD PROGRESS REPORT. R. O. McClellan, Glenda S. Vogt, W. J. Clarke, J. R. McKenney, and L. K. Bustad (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Biological effects are being observed in miniature swine fed from 1 to 3100 μC Sr^{90} daily. More than 200 animals are being maintained for lifetime observation. Three generations of animals fed 1 or 5 μC Sr^{90}/day for up to 44 months have shown no definite effects. At the 25-μC Sr^{90}/day level, a suggestion of reduction in platelet numbers was observed. Animals fed 125 μC Sr^{90}/day show a reduction in platelet and neutrophil counts to about one-half normal. No deaths occurred at this level in animals fed Sr^{90} for over two years. At the 625- and 3100-μC Sr^{90}/day levels, animals exhibit progressive thrombocytopenia and neutropenia until death at approximately nine months or three months after initiation of feeding, respectively. Offspring of animals fed 625 μC Sr^{90}/day show progressive hematological changes until death at about 100 days of age if daily Sr^{90} feeding is continued. Offspring removed from Sr^{90} feeding show a partial hematological recovery and survive. Pathological lesions noted in animals that died at the higher levels were similar to those noted in the acute radiation syndrome. Viable offspring were born at all levels of Sr^{90} feeding up to and including 625 μC/day. At 3100 μC Sr^{90}/day normal appearing near-term fetuses were observed at autopsy. Changes in Ca–Sr^{90} discrimination between diet and skeleton with increasing age were noted; the Sr^{90}/Ca ratios for skeleton formed during the periods birth to six weeks, six weeks to three months, and three months and older were 0.7, 0.4, and 0.25, respectively, of the Sr^{90}/Ca ratio of the diet. Isodose representations of the radiation dose rate to mandible and vertebra of an animal from the 25-μC/day level are shown. (auth)

35300 (HW-76000(p.84-8)) CHANGES IN Ca^{45}-Sr^{90} METABOLISM WITH AGE IN YOUNG MINIATURE SWINE. R. O. McClellan (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

The skeletal retention of Ca^{45} and Sr^{90} following a single oral dose was determined for miniature swine from 15 to 240 days of age. The highest retention of both radionuclides was observed in the youngest animals. Discrimination against Sr^{90} relative to Ca^{45} for transfer from diet to skeleton changed with age; the least discrimination was observed in the younger animals. (auth)

35301 (HW-76000(p.89-92)) ERYTHROKINETICS OF MINIATURE SWINE INGESTING Sr^{90}. R. O. McClellan, H. W. Casey, and F. F. Hahn (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

The plasma disappearance rate and erythrocyte uptake of Fe^{59} and the Cr^{51} erythrocyte survival were determined for miniature swine fed Sr^{90} daily. The initial uptake of Fe^{59} by erythrocytes was more rapid for animals ingesting 125 μC Sr^{90}/day than for controls or animals fed lesser quantities of Sr^{90}. Erythrocyte survival was altered in the high-level Sr^{90} animals suggesting a portion of the erythrocytes had a very short survival. (auth)

35302 (HW-76000(p.93-4)) ERYTHROPOIETIN IN MINIATURE SWINE INGESTING Sr^{90}. R. O. McClellan (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

An assay technique was developed and utilized to demonstrate high levels of erythropoietin in miniature swine ingesting high levels of Sr^{90}. (auth)

35303 (HW-76000(p.95-7)) STRONTIUM AND CALCIUM UPTAKE BY RAT LIVER AND KIDNEY MITOCHONDRIA. F. R. Mraz (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

The in vitro uptake of Sr^{85} and Ca^{45} by kidney and liver mitochondria was depressed by added Ca and stimulated by added Sr. ATP, but not cytochrome c, was required for uptake of Sr^{85} and Ca^{45} by kidney mitochondria. Uptake of Sr^{85} and Ca^{45} by liver mitochondria was stimulated by both ATP and cytochrome c, but only in the presence of excess Ca in the medium. (auth)

35304 (HW-76000(p.98-108)) TRANSFER OF SOME RADIONUCLIDES TO MILK. R. O. McClellan, H. W. Casey, and L. K. Bustad (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

The transfer of several radionuclides from plasma to milk following a single intravenous dose was studied in mature sheep. The rates of plasma clearance of the radionuclides for the 10 days following administration in decreasing order are: U^{233}, Cm^{244}, Ca^{45}, Ra^{226}, Sr^{90}, Pm^{147}, and Ru^{106}. The average milk-to-plasma ratios were: Ca^{45}, 30; Sr^{90}, 10; Ra^{226}, 6; Pm^{147}, 2.5; Cm^{244}, 2; Ru^{106}, 0.015; and U^{233}, 0.08. (auth)

35305 (HW-76000(p.109-10)) TECHNETIUM DEPOSITION IN THE THYROID. V. H. Smith (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Technetium-99 was not found in the thyroid of rats in the high concentration expected from literature reports, whether injected in a cationic or anionic form. (auth)

35306 (HW-76000(p.111-14)) DISTRIBUTION OF Zn^{65} AFTER INGESTION BY TROUT. R. E. Nakatani and W. P. Miller (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Yearling trout fed a dose of 8.8 μC Zn^{65} at 7 days post-administration showed the tissue distribution in descending order of concentration as follows: gill filaments, spleen, kidney, bone, liver, eye, blood, and muscle. Pilot tests on 30-month-old trout fed 880 mC Zn^{65} excreted less than 0.2% dose in the urine over a period of 3 to 4 days. The amount absorbed through the gastrointestinal tract is estimated at 40 to 50%. (auth)

35307 (HW-76000(p.115-17)) LIFE SPAN OF MICE FOLLOWING INHALATION OF PuO_2. W. J. Bair and A. D. Wiggins (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Pulmonary deposition of $Pu^{239}O_2$ (0.038 to 0.72 nC) in mice ranging in age from 122 to 369 days had no significant effect on their life span. (auth)

35308 (HW-76000(p.118-25)) CHRONIC TOXICITY OF INHALED PLUTONIUM IN DOGS. J. F. Park and W. J. Clarke (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Beagle dogs were given a single exposure to $Pu^{239}O_2$ aerosols. Two dogs died 855 and 933 days after deposition of 6 μC in the lung. Average radiation dose to the lung tissue was 12,000 rad. Dyspnea and lymphopenia were the primary symptoms prior to death. Gross and microscopic histopathological changes occurred in the lungs and associated lymph nodes which contained 80 to 95% of the Pu content of the dogs. Autoradiographs indicated radioactivity associated with histopathological changes. Increased

respiration rates and lymphopenia are the primary clinical symptoms in dogs that are alive three years post-exposure. (auth)

35309 (HW-76000(p.126-35)) RETENTION, TRANSLOCATION, AND EXCRETION OF $Pu^{239}O_2$. W. J. Bair (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

In dogs tissue distribution and excretion of Pu varied with the chemical form and particle size of the inhaled Pu aerosol. (auth)

35310 (HW-76000(p.136-42)) REMOVAL OF INHALED RADIOACTIVE PARTICLES. E. G. Tombropoulos and W. J. Bair (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Inhaled $Ce^{144}O_2$ was removed from the lungs and body organs by administering diethylenetriaminepentaacetic acid (DTPA) and, to a lesser degree, Pluronics F68. Pluronics was more effective than DTPA in increasing the clearance rate and urinary and fecal excretion of inhaled PuO_2, but neither decreased the body burden of PuO_2 to any appreciable extent. (auth)

35311 (HW-76000(p.143-8)) PREVENTION OF PLUTONIUM AND NEPTUNIUM DEPOSITION. V. H. Smith (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Diethylenetriaminepentaacetic acid (DTPA) and other agents were tested in rats for their effectiveness in preventing Pu and Np deposition in bone. DTPA was most effective, exercising greater effect on Pu than on Np. Effects of these agents on toxicity are also noted. (auth)

35312 (HW-76000(p.149-55)) EFFECTS OF PLUTONIUM IN SKIN AND ITS REMOVAL. J. W. Cable, Beatrice J. McClanahan, V. G. Horstman, D. H. Wood, and L. K. Bustad (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

One to two years after swine were intradermally injected with 0.0016 to 5 μC of Pu^{239}, scabs and indurated areas characterized many of the sites injected with 0.04 μC or more of Pu^{239}. Lesions caused by Pu^{239} were more severe than those caused by equivalent μC amounts of Pu^{238}. Over 10% of the intradermally injected Pu^{239} appeared in the regional lymph nodes one week after injection. Na_3Ca DTPA did not cause increased translocation of subcutaneously injected Pu while surgery removed most of the Pu from the injection site. DTPA increased urinary excretion and decreased liver and bone burdens of Pu. Additional swine were intradermally injected with Np^{237}. (auth)

35313 (HW-76000(p.156-60)) RADIATION PROTECTIVE EFFECTS OF CHELATING AGENTS. V. H. Smith (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Preliminary experiments in rats show that chelates are protective against hematopoietic death. At radiation doses above the $LD_{50/30}$ they rapidly become ineffective. (auth)

35314 (HW-76000(p.161-6)) BONE MARROW TRANSPLANTATION EFFECTS ON LIVER AND SPLEEN PHOSPHATASE. E. M. Uyeki (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Inoculation of mice with foreign hemopoietic tissue resulted generally in an increased acid phosphatase level in spleen and liver, associated with an increased organ weight. The pattern of response resembled that seen following introduction of an inert macromolecular substance. (auth)

35315 (HW-76000(p.167-73)) SECONDARY DISEASE STUDIES. E. M. Uyeki (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Lethally x-irradiated mice receiving bone marrow from donors pretreated with host tissue showed enhanced survival, compared to animals receiving bone marrow from normal donors. Humoral antibody production was demonstrated in these chimeras against both host and graft tissues. (auth)

35316 (HW-76000(p.174-7)) I^{131}-LABELED ROSE BENGAL DYE BLOOD CLEARANCE AS A LIVER FUNCTION TEST IN SHEEP. H. W. Casey, R. O. McClellan, W. J. Clarke, and L. K. Bustad (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). (HW-SA-2974)

Blood clearance of I^{131}-labeled rose bengal dye was used to measure liver function in sheep. Two hepatotoxic agents, CCl_4 and Np^{237}, were used to determine the sensitivity of the test. Clearance rates differed only slightly for sheep of different age groups and in those placed in different body positions. (auth)

35317 (HW-76000(p.178-82)) COMPARATIVE EFFECTS OF RADIATION, COPPER, AND MOLYBDENUM. P. L. Hackett (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Preliminary investigations on the effect of feeding high dietary levels of Cu and Mo to irradiated and non-irradiated rats did not indicate that these elements produced many marked effects on the parameters under consideration. Changes in urinary Cu excretion occurred in animals receiving x irradiation in the lethal range. (auth)

35318 (HW-76000(p.183-6)) ZINC-CADMIUM INTERRELATIONSHIPS. Beatrice J. McClanahan and H. A. Kornberg (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

In vitro studies on the transport of Zn^{65} and Cd^{115m} using cellophane membranes demonstrated that the two elements behave independently of each other. When everted intestinal sacs were used, no interaction existed between the two elements. The absorption of $Cd^{115m}Cl_2$ from the gastrointestinal tract of the rat was less than the absorption of $Zn^{65}Cl_2$; however, it was retained by many tissues longer than Zn^{65} was. As the dietary level of stable Cd was increased, the uptake of intraperitoneally administered $Zn^{65}Cl_2$ increased in the liver and pancreas and decreased in the small intestine. (auth)

35319 (HW-76000(p.187-97)) EFFECTS OF DEUTERIUM OXIDE AND RADIATION ON YEAST AND FISH. R. T. O'Brien and M. P. Fujihara (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

The effects of D_2O on growth, respiration, and metabolism in yeast were measured. Glycolysis was inhibited by D_2O. Deuterated glucose had little effect on either respiration rate or uptake in either D_2O or water, indicating that deuterium effects were not due to isotopic inhomogeneity. Radiation effects on leakage from yeasts which catabolize glucose by different pathways were studied. Effects on leakage of K, but not phosphate, were related to initial cellular contents. The effects of radiation and D_2O were studied in the fresh water cichlid fish, Aequidens portalegrensis. An LD_{50} at seven days of 375 ± 25 r and of 2.12 ± 0.12 kr of x rays was observed, respectively, for embryos and larvae of the fish. Marked stimulation of a muscular and/or nerve response was noted in young larvae. An avoidance response to a gamma source (emitting less than 5 rad/hr at a 1-in. distance in H_2O) was observed in young

but not old larvae. Embryos tolerated up to 10% D_2O with no effect on hatching or survival. Larvae tolerated up to 30% D_2O with no effect on survival. Effects of D_2O on larvae appeared to be irreversible. (auth)

35320 (HW-76000(p.198-201)) EFFECTS OF RADIATING SINGLE AND MIXED SPECIES OF BEETLES. H. E. Erdman (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Effects on reproductive abilities, induced dominant lethals, and life spans were investigated for single- and mixed-species cultures of flour beetles, T. confusum and T. castaneum, given x radiation. T. castaneum was more x-ray tolerant. Co-existence as well as 2 kr x-radiation reduced T. confusum progeny. (auth)

35321 (HW-76000(p.202-7)) EFFECTS OF DRUGS ON SALT ABSORPTION BY PLANTS. R. L. Uhler (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Chloramphenicol reduces the absorption of cations in two plant genera, Hordeum and Pisum, while absorption of phosphate is not appreciably altered. Benzimidazole is toxic at levels reported to enhance salt absorption and enhancement does not occur when intact plants are grown in complete solutions. (auth)

35322 (HW-76000(p.208-10)) PLANT UPTAKE OF Sr^{90} AND Cs^{137} FROM FIELD PLOTS. J. F. Cline (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Time after the soil was contaminated had negligible effect on the percent of Sr^{90} removed from a local basic soil by a crop. Cesium-137 accumulation in bean plants was not depressed by the addition to the soil of various quantities of K. Relative uptake of Cs^{137} was approximately 100-fold less than Sr^{90} and Sr^{85}. (auth)

35323 (HW-76000(p.211-14)) REACTOR EFFLUENT MONITORING, 1962. P. A. Olson and R. E. Nakatani (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Chinooks reared for 11 weeks in 0, 3, 5, and 7% reactor effluent showed growth inhibition due to effluent. This inhibition is attributed to the presence of dichromate. Significantly higher mortalities were observed for the 5 and 7% effluent groups but not for the 3%. (auth)

35324 (HW-76000(p.215-18)) CHINOOK SALMON SPAWNING NEAR HANFORD, 1962. D. G. Watson (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

The number of chinook salmon nests in the Columbia River near Hanford was the second highest since surveys were started in 1947. Spawning was again particularly dense in the Midway region apparently due to barrier effects of the Priest Rapids Dam. (auth)

35325 (HW-76000(p.219-22)) SWIMMING PERFORMANCE OF CHINOOK SALMON REARED IN REACTOR EFFLUENT. R. E. Nakatani (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Comparisons between the average swimming performance of 24 groups of young chinook salmon after the fish were reared in 0, 3, and 5% reactor effluent showed no difference when tested at a water velocity of 1.6 fps. The exponential curve, $y = (9400)\ (0.16)^x$ where y equals the performance time in seconds and x equals the water velocity in fps, estimates the performance of control chinooks tested at various water velocities. (auth)

35326 (HW-76000(p.223-6)) INCIDENCE AND VIRULENCE OF COLUMNARIS. [PART] II. P. A. Olson and M. P. Fujihara (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Sampling of salmon in the Columbia River indicated that C. columnaris was widely distributed. Juvenile rainbow trout grown in the laboratory in river water showed peak mortalities within four weeks of the first identification of the disease. Peak mortality was not correlated with maximum water temperature. Ten-month-old salmon tested for susceptibility to columnaris showed no relationship between size of individual fish and resistance to the disease. (auth)

35327 (HW-76000(p.227-31)) PLANKTON–WATER CHEMISTRY CYCLES IN THE COLUMBIA RIVER. C. E. Cushing (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Asterionella was the dominant diatom in the Columbia River; peak populations occurred in May. This increase appears related to increasing water temperatures and light penetration. Nitrate and phosphate concentrations decreased coincidently with the diatom peak, suggesting nutrient assimilation by the algae. (auth)

35328 (HW-76000(p.232-8)) SOIL MOISTURE DEPLETION IN A SAGEBRUSH AND A GREASEWOOD COMMUNITY. W. H. Rickard (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

In March, 1961, the upper 3 dm of soil in a greasewood community contained more water than the same layer under an adjacent sagebrush community. Subsequent water loss from this layer was more rapid in the greasewood community, coincident with spring leaf emergence of the deciduous greasewood. (auth)

35329 (HW-76000(p.239-43)) RADIOCESIUM IN NORTHERN ALASKAN ESKIMOS AND THEIR FOODS, SUMMER 1962. W. C. Hanson, H. E. Palmer, and B. I. Griffin (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Whole-body counts were made of native Eskimos and non-native people in northwestern Alaska. Cesium-137 body burdens were generally related to amounts of caribou and reindeer consumed. Maximum Cs^{137} body burdens occurred at Anaktuvuk Pass and minimum values among Point Hope residents. (auth)

35330 (HW-76000(p.244-57)) GAMMA-EMITTING RADIONUCLIDES IN ALASKAN FISH AND PLANTS. D. G. Watson and W. H. Rickard (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Amounts of γ-emitting radioisotopes in fish from the sea, brackish water, and freshwater streams and lakes in Alaska were measured. Naturally occurring K^{40} exceeded the quantity of the fallout isotopes by a factor of 10 to 100. Zinc-65 was present in all fish from the lakes, absent from the stream residents, and consistently present in the anadromous salmon. Highest levels of Cs^{137} occurred in the freshwater lakes that served as collecting basins for runoff from the surrounding land. Radiocesium in Alaskan plants and plant communities is related to retention and accumulations of aerially deposited world-wide fallout. Long-lived mosses and lichens with relatively few dehiscent parts showed higher Cs^{137} values than seed plants from the same habitat. (auth)

35331 (NP-13060) LECTURES IN AEROSPACE MEDICINE, FEBRUARY 4-8, 1963. (School of Aerospace Medicine, Brooks AFB, Tex.). 456p.

Separate abstracts were prepared on two sections of this

report. Papers are included that cover various aspects of aerospace medicine. (C.H.)

35332 (NP-13060(p.301-38)) NATURAL AND MAN MADE RADIATION IN SPACE. Alan Rosen (Space Technology Labs., Inc., Redondo Beach, Calif.).

The sources of radiation that man may encounter during space flight are reviewed. It is pointed out that it may be more difficult to protect against solar flare proton emanations than against charged particles trapped by the geomagnetic field of the Van Allen radiation belts. The properties of the space radiation environment are reviewed with emphasis on the newly created artificial radiation belt and the possible prediction of solar flare proton events. Some of the fundamental concepts associated with the trapped radiation belts and solar flare proton events are discussed. (C.H.)

35333 (NP-13060(p.339-64)) SHIELDING OF MAN IN SPACE. Everitt P. Blizard (Oak Ridge National Lab., Tenn.).

The two principal sources of radiation with which man in space will have to deal are those due to the reactor used as a source of power and those due to natural radiations, principally from the sun. The reactor will be the dominant source but shielding against its radiations will be made easier by the fact that its position is fixed and may be reduced by a shadow shield while the natural radiations come essentially from all directions and will require an encompassing shield. It is postulated that both a shadow shield and an encompassing shield will be necessary and that they will reinforce one another only somewhat. The properties of the radiations are reviewed and shielding materials are considered. It is concluded that the best space shielding materials will be those of low atomic weight, with hydrogen being best of all. Considerable shielding will be required for extended space missions but the exact appropriate design is still doubtful. (C.H.)

35334 (TID-17605) VARIATION IN NEONATAL DEATH AND BIRTH WEIGHT IN THE UNITED STATES AND POSSIBLE RELATIONS TO ENVIRONMENTAL RADIATION, GEOLOGY AND ALTITUDE. Douglas Grahn and Jack Kratchman (Argonne National Lab., Ill. and Division of Plans, AEC). Oct. 1962. Contract [W-31-109-eng-38]. 59p. (UAC-6969)

Variation in the neonatal death rate in selected areas of the Western United States has been evaluated with reference to the geologic environment and the presence or absence of known U and He reserves. While the neonatal death rate is unquestionably higher in the mountain regions, this cannot be attributed to higher levels of terrestrial radiation. A significant positive relation does exist between death rate and altitude. The increased death rate can be largely attributed to a lower birth weight, since the frequency of immature births, on a weight criterion, progressively increases with altitude. Immaturity is a more prevalent cause of death in the mountain states. The observed correlations with altitude can be interpreted as due either to the increase in cosmic radiation intensity or the decrease in O partial pressure, or both. The data are evaluated in terms of three hypotheses; radiation-induced mutation, radiation-induced injury to the fetus, and hypoxia-induced depression of fetal growth. Probably no more than 5 to 10% of the excess neonatal deaths can be attributed to genetic factors, and direct fetal irradiation is concluded to be of no significance. The weight of the historical, experimental, and clinical evidence indicates that the reduced partial pressure of O is responsible for the reduced fetal growth and subsequently increased neonatal death rate. (auth)

35335 (TID-17851) ELECTRON MICROSCOPY OF MITOSIS IN A RADIOSENSITIVE GIANT AMOEBA. E. W. Daniels and L. E. Roth (Argonne National Lab., Ill. and Ames Lab., Ames, Iowa). Oct. 1962. Contract W-31-109-eng-38. 31p. (UAC-7075)

Pelomyxa illinoisensis amoebae, the large radiosensitive species, were fixed in OsO_4 and embedded in either Epon 812 or methacrylate. Ultrastructural morphology is demonstrated in subnuclear structures at interphase and during specific times in mitosis. Evidence of nuclear envelope breakdown and reconstruction is presented. Fragments of nuclear envelope membranes are traced throughout metaphase and anaphase to telophase. Annuli in the nuclear envelope and its fragments are demonstrated. P. illinoisensis is unique in mitochondrial arrangement during metaphase and anaphase– mitochondria are aligned at the ends of fibrils distal to the chromosomes at the positions occupied by centrioles in other types of cells; there they remain until the end of anaphase. The radioresistant amoebae, Pelomyxa carolinensis and Amoeba proteus do not have polar mitochondria. P. illinoisensis also differs from the two radioresistant species in nucleolar morphology during interphase, and in the manner of nucleolar dissolution during prophase. On the other hand, helical coils are shown in the interphase nucleoplasm which appear similar to those in the radioresistant amoebae, P. carolinensis and A. proteus. A blister stage in the telophase of P. illinoisensis is described which is interpreted to be the result of a rapid nuclear expansion leading to interphase. This has not been observed in the radioresistant amoebae. (auth)

35336 (UCLA-515) SEMIANNUAL PROGRESS REPORT FOR THE PERIOD ENDING JUNE 30, 1963. (California. Univ., Los Angeles. School of Medicine. Lab. of Nuclear Medicine and Radiation Biology). Contract AT (04-1)-Gen-12. 87p.

Separate abstracts were prepared for 6 sections of this report. (C.H.)

35337 (UCLA-515(p.15-31)) BIOCHEMISTRY. (California. Univ., Los Angeles. School of Medicine. Lab. of Nuclear Medicine and Radiation Biology).

Progress is reported in tracer studies of enzymatic decarboxylation of long-chain fatty acids of rat brain microsomes. A relation of aging and a degradative system for brain fatty acids that functions as a disposal mechanism is postulated. Data are included from studies of fat metabolism and function in single cultured heart cells; the Ca and Mg requirements and ATP-induced contraction of glycerol-extracted heart cells; the direct effects of 10 to 700 Mrads of γ radiation on long-chain fatty acids; and the chromatographic separation of natural waxes of the ornamental rubber plant, Ficus elastica, and other natural waxes. (C.H.)

35338 (UCLA-515(p.33-46)) RADIOBIOLOGY. (California. Univ., Los Angeles. School of Medicine. Lab. of Nuclear Medicine and Radiation Biology).

A rapid method is described for determining tritium water in urine following acute exposure. Progress is reported in studies of the radiation chemistry of thymine in aqueous alkaline solutions; the effects of inorganic ions on some radiation chemical yields in aqueous solutions; the effect of pH on the sensitivity of γ-irradiated purines in aqueous solution; the effect of estrogens on protein metabolism in chicken liver; the synthesis of hematin in chick embryos; the relation between hematin synthesis and morphological structures in adult and fetal red cells in chickens; radiation effects on erythropoiesis and longevity

in rats; and tracer studies of metabolism in Euglena gracilis. (C.H.)

35339 (UCLA-515(p.47-54)) PHARMACOLOGY AND TOXICOLOGY. (California. Univ., Los Angeles. School of Medicine. Lab. of Nuclear Medicine and Radiation Biology).

The sequence of events in 3 modes of radiation death, hematopoietic, gastrointestinal, and central nervous system, was studied. It was shown that chemicals can protect against the first two types of death but the massive damage that occurs in the central nervous system death cannot be ameliorated with any of the known radioprotectant drugs. A survey of over 1300 compounds used as radioprotective agents led to the conclusion that the most effective compounds contain an amino group and 2 carbon atoms from a sulfhydryl group, but there are varying degrees of activity even in the same series of compounds. The mercaptoalkylisothiouronium derivatives are the most effective compounds presently available. Results are reported from studies of the pharmacology and toxicology of Tb, Tm, and Yb chlorides in rats, and Eu in guinea pigs and rabbits; pyridoxine absorption from the small intestine of x-irradiated rats; and skin reactions to intradermal injections of rare earths in guinea pigs. (C.H.)

35340 (UCLA-515(p.55-73)) NUCLEAR MEDICINE. (California. Univ., Los Angeles. School of Medicine. Lab. of Nuclear Medicine and Radiation Biology).

Recent advances in the development of diagnostic tracer techniques reviewed include the use of Hippuran I^{131} radiorenograms for the diagnosis of renal diseases; the use of colloidal aggregates of human serum albumin I^{131} to perform photoscans of the heart, liver, spleen, stomach, and salivary glands; the labeled Rose Bengal test of liver function and tracer techniques for the study of liver blood flow; lung photoscans after the administration of large particle aggregates of radioalbumin; and radioisotope cerebrograms for the evaluation of intracerebral abnormalities. The retention of Cs^{137} in an accidentally exposed subject studied by whole-body counting from day 189 through 582 following exposure established an 80-day half time for the long-term component of the total dose. Results of whole-body counts of γ-emitting radionuclides in newborn infants, stillborns, and children aged 4 to 15 yr are compared. The role of thymus, lymphoid tissue, and desoxyribonucleic acid (DNA) in leukemogenesis in mice and the oncogenic properties of polyoma virus DNA in mice were studies. Pretreatment of mice with AET plus 5-HT was 10 times more effective in increasing the mean survival time of mice exposed to 1200 r whole-body γ radiation than when given after the same dose of x radiation. Significant advances are reported in the packaging of both liquid and solid state polyvinyl alcohol–tetrazolium blue dosimeter systems for use in estimating depth dose distribution in large specimens of beef or fish during radiation processing. (C.H.)

35341 (UCLA-515(p.75-80)) BIOPHYSICS. (California. Univ., Los Angeles. School of Medicine. Lab. of Nuclear Medicine and Radiation Biology).

Design features are described for a scintillation detector for use in high-speed γ scanning. Results of studies on the effects of extracorporeal blood irradiation on the blood picture in mice and rabbits are discussed. (C.H.)

35342 (UCLA-515(p.81-98)) ENVIRONMENTAL RADIATION. (California. Univ., Los Angeles. School of Medicine. Lab. of Nuclear Medicine and Radiation Biology).

Results are summarized for ecological studies on plants and rodents at the Nevada Test Site. Data are included from a study of the effect of chelating agents on the uptake of Y^{91}, Ru^{106}, Ce^{144}, and Pm^{147} by bean plants grown in a calcareous soil; the characteristics of the fallout pattern of the Shot Small Boy, on July 14, 1962; the characteristics of fallout from a deeply buried nuclear detonation; the close-in effects of an underground nuclear detonation on vegetation; the effect of root temperature and oxygen supply on the uptake of fission products by plants; the effects of topography and local meteorological conditions on the deposition of fallout; and the use of computers for conversion of radiometric data arising from radiation counting and radiochemical procedures. (C.H.)

35343 (JPRS-20520) MEDICAL RADIOLOGY. Translation of Meditsinskaya Radiologiya, 8: No. 5, 39-43; 79-82 (1963). 17p. (OTS-63-31468)

Translations of two articles are presented. (C.H.)

35344 (JPRS-20520(p.1-7)) RADIATION EXPOSURE OF MEDICAL PERSONNEL DURING WORK WITH Au 198 GRANULES IN NEURO-ONCOLOGICAL CLINICS. A. A. Volkov and N. K. Muratkhodzhaev. Translated from Med. Radiol., 8: No. 5, 39-43(1963).

Radiation safety procedures for physicians during the administration of granular Au^{198} in the treatment of brain tumors are discussed. It is suggested that the patients should be placed in isolated rooms provided with Pb screens to reduce the hazards of irradiating other patients and hospital personnel. (C.H.)

35345 (JPRS-20520(p.8-16)) THE PROTECTIVE AND THERAPEUTIC EFFECT OF SYNERGISTIC ACTION OF EFFECTIVE SUBSTANCES ON THE OUTCOME OF RADIATION SICKNESS IN ANIMALS. A. M. Stashkov and V. P. Korotkova. Translated from Med. Radiol., 8: No. 5, 79-82 (1963).

Results are reported from a study of the protective and therapeutic effects of different compounds of cystamine, purine and pyrimidine compounds, vitamin B_6, and narcotics in mice exposed to 700 r x radiation. Observations were continued for 30 days after irradiation. The prophylactic use of cystamine combined with antifein led to a survival of mice by 56% as compared with controls. The administration of cystamine before irradiation, antifein immediately after irradiation, and vitamin B_6 for 7 successive days after irradiation caused an increase of 60% in the survival rate. The protective effect of antifein was increased when chloral hydrate was given before or after irradiation. The protective effect of antifein is attributed to its stimulating action on the hypophyseal-adrenal cortical mechanism and hypothalamus. (C.H.)

35346 (JPRS-20630) STUDIES OF RADIATION IN MARINE BIOLOGY. Translated from Tr. Sevastopol'sk. Biol. St., Akad. Nauk SSSR, 13: 275-92; 305-8(1960). 32p. (OTS-63-31523)

Separate abstracts were prepared for translations of two articles. (C.H.)

35347 (JPRS-20630(p.1-25)) RADIOACTIVE ISOTOPES AND IONIZING RADIATIONS IN MARINE BIOLOGY. G. G. Polikarpov. Translated from Tr. Sevastopol'sk. Biol. St., Akad. Nauk SSSR, 13: 275-92(1960).

Applications of radioisotopes in marine biological studies are reviewed. Results are reported from studies using C^{14} to determine the primary productivity of phytoplankton in the Mediterranean Sea and in determinations of the rate of photosynthesis of algae in oligotrophic areas of the ocean. Results are also summarized from a number of metabolic

studies on marine organisms in which radioisotopes were used as tracers. (C.H.)

35348 (JPRS-20630(p.26-31)) THE RADIOACTIVITY OF SOME REPRESENTATIVES OF BLACK SEA PLANKTON, BENTHOS AND NEKTON. A. D. Akamsin, V. P. Parchevskii (Parchevskiy), and G. G. Polikarpov. Translated from Tr. Sevastopol'sk. Biol. St., Akad. Nauk SSSR, 13: 305-8(1960).

Analysis of mass organisms of the Black Sea for radioactivity showed an increase in 1960 due to the accumulation of fission products from atmospheric fallout. (C.H.)

35349 PREPARATION OF ^{35}S-LABELLED 6-AMINOPENICILLANIC ACID. Lars Nathorst-Westfelt, Bengtarne Schatz, and Hugo Thelin (Research Labs, AB Astra, Södertälje, Sweden). Acta Chem. Scand., 17: 1164-5(1963). (In English)

A method is described for the preparation of S^{35}-labeled 6-aminopenicillanic acid. About 27% of the radioactive sulfur added was present in the penicillin formed in the broth. About 60% was isolated as crystalline potassium penicillin. (P.C.H.)

35350 THREE SEQUENTIAL EXPERIMENTS IN RADIATION TREATMENT OF CERVICAL CANCER. Charles E. McLennan, Malcolm A. Bagshaw, and Margaret T. McLennan (Stanford Univ., Palo Alto, Calif.). Am. J. Obstet. Gynecol., 84: 1222-3(Nov. 1, 1962).

Comparative results in three types of radiotherapy are reported and the complications of treatment are described. Group I received conventional (200-kv) x-ray therapy combined with repeated treatments with 100 mg Ra; group II was given a single Ra application over 70 hr in addition to x rays; whereas group III received supervoltage (4.8-Mev) treatment with the linear election accelerator along with Ra implantation. The 5-yr survival rates in the 1st two groups were 40 and 47%, significantly lower than the 3-yr survival rate of 71% in the 3rd group. Moist desquamation of the skin did not develop with linear accelerator therapy and radiation cystitis was mild. No femoral neck fractures occurred, and leukopenia was not a problem. Incidence of intestinal symptoms and complications was high; only 16% treated with the linear accelerator had no intestinal symptoms. Transient diarrhea, cramps, or bleeding during therapy was reported by 69%, and 15% had either late or persistent symptoms and signs of radiation proctitis and sigmoiditis. The results did not settle the question of divided vs single Ra application, but the shift to a solitary and more protracted application did not diminish the survival rate. (BBB)

35351 CORRELATION OF RADIOSENSITIVITY TESTING WITH THERAPEUTIC OUTCOME IN CERVICAL CARCINOMA. Burton C. Dyson and William T. Read, Jr. (Cooper Hospital, Camden, N. J.). Am. J. Obstet. Gynecol., 86: 200-1(May 5, 1963).

An investigation was made of the validity of early postradiation biopsy of carcinoma of the cervix to predict the ultimate response of individual patients to radiotherapy. This was suggested as a guide in selecting cases for early supplementary surgical excision when a poor prognosis from radiotherapy alone is anticipated. A high rate of salvage by supplementary surgical excision after clinically demonstrated failure of radiotherapy, and after recurrence, was previously reported. In 56 cases of cervical carcinoma treated with radiotherapy a study was made to detect a correlation between postradiation radiosensitivity testing (RST) and ultimate therapeutic response. Most of these cases received both Ra (average 4700 mg-hr) and x-ray treatment (average 4200 r to the pelvis). The histologic criteria used required for a diagnosis of good RST, a definite increase in differentiation of cells in the finger-like growing edges of tumor in the postradiation biopsy. Considering all stages of cervical carcinoma together, the correlation of RST with subsequent response to radiotherapy was slightly poorer than chance alone (50%); a good RST being followed by a good therapeutic result in 48% of cases. A poor RST was followed by a poor therapeutic result in 29% of cases. As in previous studies, the stage of the cancer had a much better correlation with the therapeutic result than did radiosensitivity. Thus, under conditions of this study, RST did not prove useful in following the patient with carcinoma of the cervix treated with radiotherapy. (BBB)

35352 EVALUATION OF XENON AS A GASEOUS ROENTGENOGRAPHIC CONTRAST MATERIAL. A PRELIMINARY REPORT. S. David Rockoff (National Inst. of Health, Bethesda, Md.) and Mortimer L. Mendelsohn. Am. Rev. Respirat. Diseases, 86: 434-8(Sept. 1962).

The roentgenographic properties of the chemically inert gas Xe were studied in a phantom whose proportions were designed to simulate a human chest. The experiment was performed utilizing 30-, 60-, and 100-kvp x rays and varying amounts of added Al filtration, ranging from 0.5 to 2.0 mm. A system of densitometry was used that included the pre-exposure of a portion of all roentgenograms with a step wedge to be used as a frame of reference and to determine film response. Xenon, in path-lengths ranging from 1.04 to 9.80 cm, casts a faint roentgenographic shadow relative to air; and differences of radiopacification can be seen visually as well as detected densitometrically. The difference of radiopacification of Xe relative to air, as determined densitometrically, is accentuated in exposures made at 30 and 60 kvp relative to those made at 100 kvp, but no difference can be detected between exposures made at 30 kvp and those made at 60 kvp. Addition of 0.5 to 2.0 mm Al filtration has no effect on the relative radiopacification of Xe and air at 60 to 100 kvp, but diminishes this relative radiopacification at 30 kvp. Thus, it may be advantageous to make exposures of the chest at 60 kvp with 2.0 mm of added Al filtration when using Xe as a gaseous contrast medium. A linear relation was found between centimeters of Al and centimeters of Xe, obtained by performing a regression analysis on all of the values obtained at 60 kvp, with 0 to 2.0 mm Al filtration, for a chest phantom with an antero-posterior dimension of 20 cm. A pilot study was undertaken to ascertain the actual magnitude of the roentgenographic shadow caused by Xe in the lungs of a patient with clinically normal pulmonary dynamics. The results of this preliminary clinical study indicated that the radiopacification due to Xe is insufficient to be readily useful with ordinary roentgenographic techniques. (BBB)

35353 A SIMPLE METHOD FOR DIFFERENTIAL ASSAY OF TRITIUM AND CARBON-14 IN WATER-SOLUBLE BIOLOGICAL MATERIALS. Darwin J. Prockop and Paul S. Ebert (Univ. of Pennsylvania, Philadelphia and Philadelphia General Hospital). Anal. Biochem., 6: 263-71 (Sept. 1963). (In English)

A Methyl Cellosolve-toluene phosphor solvent system is described for the differential determination of absolute levels of tritium and C^{14}, as well as for the determination of H^3/C^{14} dpm ratios in water-soluble biological samples by liquid scintillation counting techniques. A plot of H^3/C^{14} cpm vs H^3/C^{14} dpm determined using the system is linear over wider range than are two other counting systems developed for the counting of water-soluble samples. H^3/C^{14}

cpm ratios counted with the Methyl Cellosolve-toluene system are relatively stable in the presence of HCl and NaCl contamination, and thus the solvent system can be used in the initial determinations of H^3/C^{14} ratios of evaporated HCl hydrolyzates and other partially purified biological materials. Activities in dilute solutions of C^{14}- and tritium-labeled proteins can also be differentially determined using the solvent system. (P.C.H.)

35354 ^{14}C AND ^3H SPECIFIC ACTIVITIES BY BOMB COMBUSTION AND SCINTILLATION COUNTING (BOMB COMBUSTION OF ^{14}C AND ^3H). A. S. McFarlane (National Inst. for Medical Research, London) and K. Murray. Anal. Biochem., 6: 284-7(Sept. 1963). (In English)

A modified, conventional oxygen bomb calorimeter that gives quantitative combustions of small amounts of nonvolatile solids (mainly proteins) arising from biological experiments with C^{14} and H^3 is described. After firing, the bomb is opened to a vacuum line and the total gases condensed at the temperature of liquid nitrogen. Oxygen is then pumped away and residual $C^{14}O_2$ and H_2^3O separated in vacuo for scintillation counting. Advantages of the procedure over alternative procedures are that masses of CO_2 and H_2O required to calculate specific activities are measured immediately before counting and, in the case of $C^{14}O_2$, no water vapor is carried over into the scintillator. (P.C.H.)

35355 SELECTIVE DESTRUCTION OF CANCERS AFTER EXPOSURE TO HEAT. George Crile, Jr. (Cleveland Clinic Foundation). Ann. Surg., 156: 404-7 (Sept. 1962).

Experiments in mice, dogs, and humans show that heat selectively damages tumor cells and makes them more sensitive to ionizing radiation. Observations on the effect of heat and radiation on three types of transplantable tumors in mice show that the destructive effects of heat begin at 42°C, at which temperature it takes several hours to damage tissues. For each degree that the temperature rises above 42°C, the time of exposure required to obtain the same biologic effect can be halved so that exposure of less than a minute at 49° is equivalent to 2 hr at 42°. The tumors were transplanted to the hind feet of mice and were heated in a constant-temperature bath. The tumors showed a spectrum of heat sensitivity that correlated closely with the radiosensitivity of the same kind of tumors. The effects of radiation on even the most radioresistant tumors as well as on normal tissues was greatly increased when the tissues were heated just before or just after the radiation was given. Although heat-resistant cancers that are heated to 44°C for 30 min. before they are irradiated can be destroyed by less than half the dose of radiation that is normally required, heating induces a similar potentiation of the radiation effect on normal tissues. It is thus difficult to be sure that radiation combined with heat is any more effective than a larger dose of radiation would be if given alone. However, some radioresistant tumors, such as the T241 sarcoma implanted on the feet of C57BL6 mice, can be controlled by heat and radiation without damage to the foot, whereas larger doses of radiation alone usually fail to cure, or in doing so damage the normal tissues. A higher proportion of mice with S91 melanoma also can be cured by combining radiation and heat than by employing either treatment alone. It was also established that there are tumors in dogs and man that can be selectively destroyed by heat without damage to the surrounding tissues, but these heat-sensitive tumors are rare, and unless they are superficially located there is as yet no safe way to apply the heat. More practicable from the clinical standpoint is the use of heat to potentiate the effects of radiation. This was employed in cutaneous recurrences of human breast cancer, and in the treatment of a malignant myoblastoma of the face, metastatic adenosarcomas in the liver, osteogenic sarcomas, and metastatic carcinomas and sarcomas in bone. Heat sensitized the superficially heated tumors to radiation, so that after immersion of the skin in a bath at 44° to 46°C for an hour, a single 600 r dose may destroy the tumor. In the conventional x-ray treatment, 1500 r or more would be required to accomplish the same result. It seems that the inflammatory reaction that follows heating rather than the heat itself selectively destroys the tumor. Of a large number of compounds tested to increase the effectiveness of heat, the only one that was consistently effective was serotonin. To a much lesser extent histamine, angiotensin, carbolines, and ethyl alcohol were effective. None of the most commonly used anticancer agents increased the effectiveness of heat. When 2.5 mg of serotonin is injected in a tumor before it is heated, the tumor can be destroyed with less than half of the exposure to heat that is normally required. Since serotonin is involved in inflammation, this also suggests that inflammation is involved in destruction of tissue after heating. (BBB)

35356 SKIN CARCINOMA DEPTH AND DOSE HOMOGENEITY IN DERMATOLOGICAL X-RAY THERAPY. H. R. Atkinson (Dominion X-Ray and Radium Lab., Christchurch, N. Z.). Australian J. Dermatol., 6: 206-15(June 1962).

A study was made of cancerocidal dose-time relations in the radiation treatment of skin carcinomas, in an attempt to combine into a practical scheme, parameters such as field sizes, depth doses, dose homogeneity, depth of lesions, and optimum fractionation of dose. For all skin carcinomas, irrespective of cell type, ~50% of the lesions infiltrate to only 2 mm or less, and 75% to 5 mm or less. This is true particularly for all basal cell and selected squamous cell types. For unselected squamous cell carcinomas, 50% infiltrate to 5 mm or less. Dose homogeneity, the ratio of the surface dose to the dose at the base of the lesion, is the inverse of depth dose. For a perfectly homogeneous dose distribution with 100% of the surface dose at the base, the ratio or the homogeneity factor is 1.0. If the base of the lesion is at the half-value depth (HVD), i.e., at the 50% level, the homogeneity factor is 2.0. Two criteria for homogeneity, allowing some clinical choice, were adopted: either 75 or 50% depth corresponds with the base of the lesion. Depth dose data are provided for radiation qualities from HVL 0.02 mm Al to HVL 4 mm Al, 10 and 15 cm focus skin distances, and field sizes from 1.6 cm to 5.6 cm dia, i.e., 2 to 25 cm^2 area. The resultant smoothed 75%, 50%, and 10% depth values are plotted. These depth curves represent the depths at which a given proportion of the skin dose is delivered over the range of qualities. For lesion depths of 2 and 5 mm the choice of homogeneity with 75% of the skin dose delivered to the base of the lesion, or the less stringent criteria with 50% skin dose to the lesion base, are represented by the points at which the 75% depth and 50% depth curves respectively cut the 2 mm and 5 mm depth levels. At the radiation qualities represented by these points these criteria are just met, at harder qualities they are more than just met, and at softer qualities they are not reached. By reading off these qualities, physical indications may be derived. The softest quality that will meet the proposed criteria is equivalent to an HVL of 0.13 mm Al. Techniques softer than this, approaching the grenz region, are indicated only for selected, very superficial lesions and for those lesions where doses to underlying tissue are critical. (BBB)

35357 THE IODIDE POOL OF THE THYROID STUDIED BY MEANS OF THE ISOTOPIC EQUILIBRIUM METHOD AND DOUBLE LABELLING WITH ^{125}I AND ^{131}I. Claude Simon (Commissariat a l'Energie Atomique, Saclay, France). Biochim. Biophys. Acta, 74: 565-7(Aug. 13, 1963). (In English)

The amount of iodide present in the rat thyroid was measured by the isotopic equilibrium method without any pharmacological intervention. By combining this method with double labeling it was possible to study the kinetics of iodide turnover and to estimate the importance of recycling. For rats fed 5 μg of iodine per day (22 animals), 0.30 ± 0.03 (S.D.) % of the total iodine of the thyroid (10.5 ± 2.1 μg iodine) is in the form of iodide, 0.0316 ± 0.008 μg. For rats fed 50 μg of iodine per day (26), 0.45 ± 0.01% of the total iodine of the gland (15.9 ± 2.3 μg) is in the form of iodide, 0.0709 ± 0.0234 μg. The results support the hypothesis of a single iodide pool in which the turnover is determined by two fluxes (recycling and uptake) whose relative participation has been estimated. (P.C.H.)

35358 DENSITY DETERMINATION IN A PREFORMED GRADIENT OF CESIUM CHLORIDE. A. Polson and Julia Levitt (Univ. of Cape Town). Biochim. Biophys. Acta, 75: 88-95(July 23, 1963). (In English)

A simple procedure for forming density gradients is described. By introducing the sample at a level close to the equilibrium position in a preformed gradient of CsCl, the time of centrifugation may be considerably shortened. The method applied to hemocyanin, MEF_1 poliovirus, and Rift Valley fever virus gave densities of 1.32 and 1.23 g/ml, respectively. (auth)

35359 ESTABLISHMENT OF A RADIOISOTOPE SECTION IN THE LABORATORY DEPARTMENT OF A NON-UNIVERSITY HOSPITAL: JUSTIFICATION, PRACTICAL APPLICATION, AND RESULTS. P. Mascart (Institut Medico-Chirurgical d'Anderlecht, Belg.). Bruxelles-Med., 42: 1204-10(Oct. 14, 1962). (In French)

A radioisotope unit was established in a non-university hospital in Anderlecht for diagnosis and treatment of conditions that do not respond to traditional procedures. Before such a lab could be established, three practical problems had to be solved. Radioisotopes had to be obtained in small enough quantities for individual studies; equipment had to be chosen so as to obtain max sensitivity of measurement and to provide adequate maintenance and adaptability of facilities for both present and future needs; and the premises had to be adapted to ensure sufficient protection against radiation. The basic principle of this limited lab was to use isotopes solely in cases where no other method of obtaining information suffices. The most frequent actual uses were: in studies of patients whose basal metabolism failed to coincide with clinical symptoms; in studies of blood volume to aid surgery, especially in cases requiring extracorporeal circulation; in studies of red cell survival and iron metabolism in hematologic disorders; and in determining cardiac function and the possibility of measuring coronary flow. The lab is of further benefit for training hospital interns, in medicine and surgery, in the investigation and application of radioisotope techniques relating to clinical problems. (TCO)

35360 A THEORY OF RETINAL BURNS. J. J. Vos (Inst. for Perception RVO-TNO, Soesterberg, Netherlands). Bull. Math. Biophys., 24: 115-28(July 1962).

Attempts are made to quantitate the thermal events involved in the production of retinal burns, which may be accidental (eclipse blindness, flash burns from watching nuclear detonations) or intentional (in the operative technique of photocoagulation) in origin. Results of experiments by Ham et al., on retinal flash burns in rabbit eyes were analyzed. It is concluded that their findings cannot be explained in the simple terms of a critical temperature beyond which burns are produced; the temperature is raised beyond the boiling point of the tissue fluid, and the production of steam must be taken into consideration. Thus, it appears from the present investigation that retinal damage is closely related to the estimated degree of steam production. However, functional damage might also occur at a much lower level of irradiation, since between 45° and 60°C proteins begin to coagulate. It also seems plausible that a still smaller temperature increase, of only a few degrees, might produce temporary lesions after prolonged exposure, by the process of metabolic poisoning which occurs when the waste products of the accelerated metabolic processes cannot be removed quickly enough. Although data from the nuclear explosions at Nagasaki and Hiroshima report only one case of retinal burn, several cases are reported from nocturnal nuclear explosions in the Nevada tests. The thermal events in these cases are complicated by the change in the temperature of the luminous fire-ball with time, by the influence of the distance of observation, and by the speed of the blinking reflex. As far as can be ascertained, the observed phenomena can be well-explained by the above theory in terms of retinal warm-up. (BBB)

35361 IONIZING RADIATION AND THE PHYSICIAN. John R. Brown and Anita A. Jarvis (Univ. of Toronto). Can. Med. Assoc. J., 88: 939-42(May 4, 1963).

Responsibility of the medical profession for the exposure of large numbers of the population to diagnostic radiation is reviewed; and practices of using radiation and measures for reducing patient exposure are discussed. The importance of educating physicians in the hazards of radionuclides is implied, and the implications of I^{131}, Sr^{90}, and Cs^{137} in food supplies to human health are considered. (TCO)

35362 OBSERVATIONS ON MURINE LEUKEMIA TREATED WITH DEUTERIUM AND X-RAY. Max W. Biggs, John E. Eiselein, and George Wilcox (Univ. of California, Livermore). Cancer Res., 23: 1059-62(Aug. 1963). (UCRL-7237)

The effects of deuterium, x-ray, and deuterium plus x-ray treatments on experimental myelogenous leukemia in mice were studied. Various treatment schedules were used. Deuterium administered by mouth at a concentration of 25% produced a significant prolongation of survival. X-ray plus deuterium treatments were additive, but no synergistic effect was proved. Deuteration prior to irradiation provided some protection in White Swiss mice against the lethal effects of x ray at a whole-body dose of 700 r. (auth)

35363 HEAT AS AN ADJUNCT TO THE TREATMENT OF CANCER: EXPERIMENTAL STUDIES. George Crile, Jr. (Cleveland Clinic). Cleveland Clinic Quart., 28: 75-89(Apr. 1961).

Experiments conducted in animals and humans showed that tumors are more sensitive to heat than normal tissues and that heat sensitizes tumors to ionizing radiation. S91 melanoma implanted on the feet of DBA_1 mice could be destroyed by immersion of the feet in a water bath at 44°C for 30 min. S91 melanoma is a moderately radioresistant tumor, progressive growth of which is not controlled by radiation in doses up to 1000 r. When this tumor was heated for 30 min at 44° and immediately treated with 1000 r, there was complete regression in 20 of 25 mice. Control mice, the tumor-bearing feet of which were im-

mersed in water at 37°, showed progressive growth of their tumors, and 75% of the animals were dead in 31 days. It appeared that heat selectively killed many tumors without damaging surrounding tissues, and that it acted synergistically with radiation. It was difficult to cure the melanoma by either heat alone or radiation alone without using exposures that caused irreversible damage to normal tissues. The reason for the effectiveness of combined therapy in controlling the tumor without damage to the feet may be that the peak of the reaction to heat and the peak of the reaction to radiation occur at different times, the heat effect being immediate and the radiation effect being delayed; or it may be that a synergistic effect is exerted selectively on the tumor as compared with the normal tissues. It is unlikely that immunologic mechanisms are responsible for the disappearance of heated tumors. Tumor cells in vitro withstand more heat than in vivo. Minced tumor cells suspended in Hank's solution and heated in a sealed tuberculin syringe at 45° for 15 min (an exposure that would destroy the tumor in vivo) were still viable and produced tumors in all mice tested. Sarcoma S180, which grows rapidly, is extremely sensitive to destruction by heat; S91 melanoma, which grows slowly, is moderately sensitive to heat; and carcinosarcoma in C57 mice, which grows almost as rapidly as the S180 and much more rapidly than the melanoma, is so resistant that it was not possible to control it permanently either by heat alone or by radiation alone without damage to the foot. Successful heat and radiation treatment of several human cancers is also described. (H.H.D.)

35364 THE VALUE OF GRENZ-RAY THERAPY FOR ACNE VULGARIS. W. P. de Groot, J. R. Prakken, Ann M. J. A. Verbeek, and M. J. Woerdeman (Univ. of Amsterdam). Dermatologica, 126: 319-25(1963). (In English)

In view of recent efforts to eliminate the use of radiotherapy for benign conditions or conditions treatable by other means, to avoid the possible detrimental effects of radiation, an evaluation of this treatment of acne was made. In a controlled, double-blind study in 40 patients, one area of skin received 1600 r (in thrice weekly 100-r doses) of 10-kv x irradiation. Comparable areas of skin were sham-irradiated with the x-ray apparatus shielded by lead. In no case had the acne cleared up on the irradiated side. In about half of the cases no difference was seen between the two areas. The remaining showed a systematic difference in favor of the treated side 2-6 weeks after treatment. However, in the majority of cases no improvement attributable to grenz-ray irradiation could be ascertained. It is concluded that grenz-ray therapy of acne, at least at the dosage used, is ineffective. At these doses, inhibition of sebaceous gland secretion would not be expected to occur. Severe erythema followed by peeling was not seen in these patients. (BBB)

35365 X-RAY DIAGNOSIS DURING DELIVERY. Jan-Diether Murken (Westfälischen Wilhelms-Universität, Münster, Ger.). Geburtsh. Frauenheilk., 23: 425-37(May 1963).

A survey was made of the use of x-ray diagnostic procedures during labor, their necessity, and the possible genetic and somatic risks involved. Such procedures were carried out in 392 of 13,450 deliveries, or 2.9%. They were used mainly to determine the indications for cesarean section or surgical vaginal delivery. Since cesarean section was required in only 2.4%, there was little necessity for x-ray evaluation for this purpose. In view of the possible harm to the fetus and maternal gonads, it is suggested that x-ray procedures at labor should be curtailed and that they are probably needed in less than 3% of deliveries. (BBB)

35366 RADIATION THERAPY IN NEOPLASTIC DISEASE. Colvin H. Agnew (Univ. of Kansas, Kansas City). GP, J. Am. Acad. Gen. Pract., 26: 131-40(Nov. 1962).

Recent innovations in radiotherapy of various forms of cancer are reviewed, and new techniques for treating radiation sickness and injury are outlined. When larger areas of skin are treated with high dosage levels, the erythematous reaction may regress to a wet reaction with denudation. Aqueous 1% gentian violet produces a protective cover which may be soaked off two or three times daily, followed by a new application by nebulizer or cotton applicator. It is most important to prevent additional trauma. This skin reaction will heal in about two weeks, depending upon the area and depth of involvement. Atrophic dry areas should be protected from irritation. Zinc oxide paste provides an economic protection; however, large areas exhibiting atrophy and ectasia may ulcerate repeatedly. If there has been much vascular damage, adequate excision and skin grafting will probably be necessary. Careful attention must be given to the possibility of metaplasia and transformation into squamous cell carcinoma. The epithelial lining of the oropharynx and esophagus, when included in treatment fields, may develop mucositis near the end of treatment, but the peak reaction usually develops after treatment is completed. This may be easily observed in the oropharynx as a pseudomembranous reaction which looks very much like a monilia infection. This temporary reaction will not require intensive treatment and will respond to warm, normal saline irrigation. The mucous membrane reaction of the esophagus usually develops after ~4000 r. Thus, near the end of the 4th wk of treatment, complaints of difficulty in swallowing are expected. There is no effective treatment. Fluoroscopic examination usually does not show a detectable abnormality. The peak reaction may occur 10 days after treatment is completed, and then gradually subsides during the next three weeks. For relief from nausea and vomiting, antiemetics, vitamin B preparations, and antihistamines may be used. Yeast tablets and wine have proved very satisfactory, and a glass of wine diluted to half with water 30 min before noon and evening meals promotes appetite. If the white blood count remains above 2000 and the hemoglobin above 10 g, it is not necessary to be concerned about the hematologic picture. However, if the count falls below these levels, special consideration is required and daily hemoglobin and white blood cell determinations should be done. As a treatment policy, it is recommended that radiation be continued as long as the white blood count remains above 1000 and hemoglobin above 10 g. When hemoglobin falls below this level, transfusion is indicated. The radiation effect is dependent upon the level of tissue oxygenation. With a large field, peripheral white cell counts usually drop in about two weeks. Proctitis, a frequent complication of uterine cancer irradiation, may respond to oil enemas; however, the most effective treatment now seems to be cortisone suppositories. Sedation coupled with narcotics may have to be used for dysuria, which usually does not appear at doses >4000 r. This becomes a rather serious problem in connection with treatment of carcinoma of the bladder, but is rarely a problem in treatment of the uterine cervix. Relief from burning, urgency and frequency can usually be obtained with phenazopyridine. If retention and infection complicate the discomfort, methenamine mandelate may be used safely in combination for its antibacterial action. For postradiation vaginitis, a regimen of gentle irrigation with warm (100°F) water, hydrogen peroxide or sodium perborate, and normal saline assists healing. (BBB)

35367 SINGLE SCINTILLATION COUNTER AND RECORDING DEVICE; ITS USE AS A SCREENING TEST FOR UNILATERAL RENAL HYPERTENSION. R. W. Lambie, S. Rubin, M. B. Ozar, and H. Statland (Menorah Medical Center, Kansas City, Mo.). J. Am. Med. Assoc., 181: 582-6(Aug. 18, 1962).

Tests were conducted to determine whether the single conventional scintillation counter available in most hospitals could be used for screening patients suspected of having unilateral renal hypertension, without resorting to the use of the more costly and complicated dual system. Sixty patients were studied, using separate injections of a radioactive medium (a 25 μc dose of I^{131}-labeled iodohippurate (Hippuran)) for each kidney area. The study demonstrated: good reproducibility of the vascular phase in a given kidney, only slight scattered radiation from the opposite kidney, and a similarity of the vascular phase of the two kidneys in normal individuals. Two of the 46 hypertensive patients studied were found to have abnormal vascular patterns. The similarity of the curves over normal kidneys and the reproducibility of results over a given kidney indicate the feasibility of using this single scanning technique, as an adjunct, in screening cases of questionable renal hypertension. (BBB)

35368 CHANGES IN THE TREND OF ROENTGEN THERAPY SINCE HIROSHIMA. J. R. Orendorff (Laughlin Hospital, Kirksville, Mo.). J. Am. Osteopath. Assoc., 62: 506-8(Feb. 1963).

A survey of the literature before and after 1945 established that there has been a change in attitude concerning the use of radiation therapy, especially for benign conditions. In the example chosen, Duplay's disease (subdeltoid bursitis), this change has been reflected by a reduction of the dose, decrease in port size, an increase in filtration, and in many cases the complete elimination of retreatment or initial x-ray therapy for such conditions. Before 1945, radiation up to 2400 r in air at the rate of 300 to 350 r/day was administered for this condition, and retreatment was considered acceptable. Now, the amount recommended is about 600 r in air at a rate of 100 to 200 r/day, and retreatment is not even considered. The recommended size of port has been reduced since 1945 from 15 by 15 or 20 by 20 cm to 6 by 6 cm or less. Previously, 0.25 mm Cu was considered satisfactory filtration; now, at least 0.5 mm Cu is thought essential. An increasing number of reports have questioned the therapeutic effectiveness of radiotherapy in bursitis patients, and antirheumatic drugs in use since 1945 have offered alternate treatment. The attitude regarding the frequency and reasons for using x-ray therapy in the treatment of subacromial bursitis has also changed radically. Before 1945, x-ray therapy was considered one of the best treatments for this disease. The possible leukemogenic effect of radiation and the importance of curtailing radiotherapy in benign diseases are discussed. (BBB)

35369 AN IMPROVED CONTAINER FOR CELLS PRESERVED BY FREEZING. J. H. L. Playfair and D. E. Pegg (Royal Marsden Hospital, London). J. Clin. Pathol., 15: 591-2(Nov. 1962).

In view of the increasing interest in the preservation of bone marrow cells for long periods at low temperatures, particularly for use in restoration of hematopoietic function, a newly designed container for storing cells at –79°C in solid CO_2 is described. The optimal features of such a container are: heat transfer, rapid heat transfer is desirable; penetration by CO_2; convenience; and economy. Since thawing is probably the most critical phase of the process, thawing curves were recorded with direct-writing thermocouples sealed in various containers. The essential factor in heat-exchange is the surface area/volume ratio; when this falls below 4 cm^2/ml the thawing time increases sharply. For volumes exceeding 10 ml, only a flat sachet provides acceptable thawing times. Glass ampoules and sachets incorporating aluminum foil showed no detectable permeability to CO_2 over 24 weeks; identical sachets made of polyethylene (up to 0.25 mm thick) accumulated CO_2 rapidly. Fenwal bags were little better, and polyethylene ampoules with much thicker walls allowed slow penetration of CO_2. Tests showed the superiority of a sachet made from a laminate of aluminum and polyethylene. Sachets were sterilized by x irradiation. Of the alternatives to these sachets, glass ampoules are best for small volumes and polyethylene ampoules satisfactory for short-term storage. As a biological test, bone marrow was obtained from mice, frozen with 12.5% dimethyl sulfoxide in 5-ml polyethylene ampoules or 20-ml sachets, and kept at –79°C for a week. It was then thawed and injected intravenously into lethally irradiated (700 r, $LD_{99/30}$) isologous mice at a cell dose of 100,000 in 0.5 ml. The 30-day survival with sachet-frozen cells was better (40/56) than those frozen in ampoules (44/84), indicating that although the volume of the sachets was four times larger, more hemopoietic stem cells were preserved. (BBB)

35370 EXPERIMENTAL HEMOPOIETIC REPLACEMENT: POSSIBLE USE IN RADIOTHERAPY. Peter Ilbery (Univ. of Sydney). J. Coll. Radiologists Australasia, 4: 50-4(June 1960).

The use of bone marrow and spleen cell grafts in recovery from radiation injury is discussed. It appears that following massive whole-body radiation in humans, efforts to repopulate marrow by means of homologous bone marrow grafting have been unsuccessful because the immune response between host and donor transplant has not been overcome. It would seem more feasible to extend the range of radio- and chemotherapy by concentrating on autologous bone marrow grafting, making use of recent improvements in very low temperature storage techniques. Mouse experiments show that the radiation doses required to eliminate all leukemic cells may exceed 2000 rad, and that such high doses injure nonhematopoietic tissues, especially intestinal mucosa, so that death results in spite of successful marrow grafting. In the case of human leukemia there is no satisfactory way to determine the degree of sensitivity of the leukemic cells to radiation. Also, there is no generally available means to deliver a uniform whole-body dose to human beings to ensure that leukemic cells in some areas do not survive. However, the principal obstacle to human marrow restoration after lethal irradiation remains the problem of secondary immunologic disease. Efforts to overcome these difficulties are discussed, including the use of multiple-source irradiation facilities, low-temperature storage of autologous remission marrow, and combined chemo- and radiotherapy. Successful treatment of a case of Hodgkin's disease by such combined therapy, with marrow infusion, is described. (BBB)

35371 REPORT OF THE THOMAS BAKER MEMORIAL FELLOW FOR 1959 TO THE COLLEGE OF RADIOLOGISTS OF AUSTRALASIA. J. M. Bradley (Peter MacCallum Clinic, Melbourne). J. Coll. Radiologists Australasia, 5: 101-12(Dec. 1961).

Recent innovations in radiotherapy techniques, especially in England, are discussed, particularly in the use of high oxygen tensions to increase the radiosensitivity of cancer cells. It is suggested that in regard to this end, two ques-

tions have to be answered: is anoxia a major factor in the failure of some human tumors to respond to irradiation, or in their recurrence after initial favorable response, and secondly, if this is so, how is the problem to be attacked clinically? It is probable that some tumors are not cured because a number of cells are protected by anoxia. It is very difficult, however, to demonstrate the presence of such cells. Studies of such cells are described. Early results have been encouraging, as an analysis of individual cases shows. It is concluded that the use of high oxygen pressures during radiotherapy has sufficient theoretical background, and has shown sufficiently promising clinical results, to justify its use on a wide scale. Studies with platinum electrodes show that some time is necessary to allow tumor oxygen tension to rise to a max, especially during the early treatments when vascularity is least. The radiosensitivity of mammalian cells and time-dose relations are discussed. It is suggested that many of the well-known variations in response of tumors to irradiation can be explained in terms of the statistical probability of sterilization of all viable cells, without implying any inherent difference in their radiosensitivity—apart from that afforded by anoxia. If a tumor with 1,000,000 fully oxygenated viable cells received a dose of 2000 rad, a cure rate of ~90% would be expected. If the same tumor contained 1000 anoxic cells, a cure rate of less than 10% would be expected. These calculations are based on the assumptions that it is necessary to destroy all tumor cells to produce a clinical cure, and that survival of a single cell will produce a recurrence. Furthermore, the proportion of cells in any tumor capable of unlimited proliferation is not yet known with any certainty, and probably varies from tumor to tumor. The following topics are also extensively discussed: use of bone marrow infusions and radiosensitizers; dosages and techniques employed in numerous Western European treatment centers for conventional, megavolt, electron-beam, and radioisotope therapy. (BBB)

35372 EVALUATION AND USE OF A LARGE PLASTIC SCINTILLATOR FOR GAMMA COUNTING. James D. Cook and Leslie S. Valberg (Queen's Univ., Kingston, Ont. and Kingston General Hospital, Ont.). J. Lab. Clin. Med., 61: 317-23(Feb. 1963).

A well-type scintillation counter capable of accommodating a 1000 ml sample was constructed from a block of NE 102 plastic. The plastic phosphor is mounted on a 16 inch photomultiplier tube, which is operated with conventional electronic counting equipment including a pulse-height analyzer. The counter was used to measure Co^{60}, Co^{58}, Fe^{59}, Cr^{51}, and I^{131}. Differential counting proved superior to integral operation for each of the isotopes; it effects a two-thirds reduction of integral background while retaining more than 80% of the signal. The efficiency of the counter is comparable to that of a conventional sodium iodide well. When large sample volumes are available, the sensitivity of the large plastic phosphor is 70 times greater than the sodium iodide crystal. The plastic scintillator proved invaluable for measuring radioactivity in human excreta. A technique was developed that permits sensitive and reproducible estimation of retained radioactivity in small laboratory animals. (auth)

35373 LIQUID SCINTILLATION COUNTING OF C^{14}-LABELED HEMOGLOBIN AND HEMIN BY A MODIFIED SCHÖNIGER TECHNIQUE. David G. Nathan, Thomas G. Gabuzda, Frank H. Gardner, Virginia B. Lemire, and Alvera L. Limauro (Peter Bent Brigham Hospital, Boston and Harvard Univ., Boston). J. Lab. Clin. Med., 62: 511-16(Sept. 1963).

A rapid, reproducible method for radioassay of C^{14}-labeled hemoglobin and hemin is described. Modification of the Schöniger technique permits multiple determinations without the use of internal standards. The radioassay of compounds bearing multiple isotopic labels was examined. Suggestions are made for the proper spectral separation of various isotopes in the counting system. (auth)

35374 STUDIES ON THE CHEMICAL NATURE AND SIZE OF SEX FACTORS OF ESCHERICHIA COLI K12. Patrice J. Driskell-Zamenhof and Edward A. Adelberg (Univ. of California, Berkeley). J. Mol. Biol., 6: 483-97 (June 1962).

The P^{32}-decay inactivation technique was used to study the wild-type sex factor of E. coli K12, F_1, and a variant sex factor, F_2. Both are sensitive to decay of incorporated P^{32}. Labeled sex factors transferred into unlabeled recipient cells were shown to lose function on storage; inactivation kinetics were described by concave exponential curves, indicating the transfer of only one sex factor particle to any one recipient. Mitomycin C was employed as a specific inhibitor of net DNA synthesis. A concentration of the antibiotic having no effect on net RNA or protein synthesis was found to inhibit incorporation of P^{32} into F_1 particles and nuclei of F_1 donor cells 64 and 69%, respectively, as determined by relative rates of P^{32}-decay inactivation of the genetic elements labeled in the presence and absence of mitomycin. An inhibition of incorporation of P^{32} into F_2 and nuclei of donor cells of 68 and 64%, respectively, was observed. DNA is thus an essential constituent of the sex factors; RNA, in amounts detectable by the methods employed, is not. A comparison of the relative rates of P^{32}-decay inactivation of F_1, F_2, and bacteriophages T1 and T4 indicated that F_1 comprises between 8.5×10^4 and 2.5×10^5 P atoms while F_2 comprises between 1.9×10^5 and 5.4×10^5, upper limits being the more probable. This difference in size between the two sex factors was also demonstrated by the respective times required for transfer to recipients. The rate of sex factor transfer was estimated to be between 6.7×10^4 and 1.9×10^5 P atoms/min. This indicates that transfer is not initiated until more than six min after donor and recipient cells are mixed, although contacts between parent cells are considered to be formed as soon as mixing occurs. (BBB)

35375 A NEW SCANNING ISOTOPE, MERCURY^{197}. A PRELIMINARY REPORT. D. Bruce Sodee (Walter Reed General Hospital, Washington, D. C.). J. Nucl. Med., 4: 335-44(Sept. 1963).

The human organ localization and excretion of intravenous Hg^{197} chloride was investigated. The radiation exposure to the human kidney was reduced from 5 rads, utilizing Hg^{203} Neohydrin to .6 rad with Hg^{197} per 100-microcurie dose. Diagnostic photoscans were produced of the kidneys, liver, and spleen with far less radiation to the individual organ than with the previously recommended scanning isotope. Twenty to twenty-five times more Hg^{197} localized in brain tumor tissue than normal, but slow clearance of blood makes brain scanning impractical with unbound Hg^{197}. Chloromerodrin tagged with Hg^{197} will further reduce radiation dose to the kidney of the patient by a factor of 200. (P.C.H.)

35376 PULMONARY FUNCTION TEST USING KRYPTON-85. Hyo H. Byun, Gisela Albrecht, George W. Holmes, and Robert S. Landauer. J. Nucl. Med., 4: 345-58(Sept. 1963).

Preliminary investigation using radioactive gas for pulmonary function tests revealed promise in simplified pulmonary function studies, particularly for mass screen-

ing tests. The method and its advantages are given. (P.C.H.)

35377 A STUDY OF THE STABILITY OF NEOHYDRIN (3-ACETOXYMERCURI-2-METHOXYPROPYLUREA) LABELED WITH MERCURY-203. Leopoldo J. Anghileri (Volk Radiochemical Co., Skokie, Ill.). J. Nucl. Med., 4: 410-12(Sept. 1963).

Neohydrin labeled with Hg^{203} in dilute basic solution exhibits excellent stability for periods up to 60 days. Two separate peaks on chromatograms of Neohydrin-Hg^{203} with buffered 50% ethanol are believed to be due to an equilibrium between an anhydro form of Neohydrin

$HN = C(=O)-NH-CH_2-CH-(OCH_3)-CH_2Hg$, and the product as normally depicted, $H_2N-CO-NH-CH_2-CH-(OCH_3)-CH_2HgOH$. The biological behavior of the two forms as evidenced by the rate of elimination on intravenous administration to rabbits was essentially the same. (P.C.H.)

35378 EARLY OPERATION. A CONSERVATIVE APPROACH TO THE TREATMENT OF CHRONIC IRRADIATION INJURY. Frank W. Masters and David W. Robinson (Univ. of Kansas, Kansas City). J. Trauma, 1: 583-94 (Nov. 1961).

A survey is made of the treatment, especially by surgery, of 169 patients with dermatitis or ulcers resulting from radiotherapy. Complications of surgery occurred in 65 (39%) of the patients. The cases were reviewed in terms of: postoperative complications, stage of the disease, time interval from exposure to treatment, and method of treatment. Ranging from prolonged healing to massive fatal hemorrhage, the most common postsurgical problems appeared to be directly related to the diminished blood supply, lowered tissue vitality, and excessive fibrosis present in the radiologically damaged wounds. Clinical manifestations were divided into two major groups: radiodermatitis representing the earlier stage characterized by atrophy, telangiectasia, fibrosis, and keratosis but with an intact surface epithelium; and radiation ulcer with tissue breakdown, infection, and malignant degeneration. If therapy is instituted after the epithelial covering of the injured area is broken, the complication rate rises rapidly. This indicates that early surgical therapy is the procedure of choice. The highest incidence of postoperative difficulty occurred in those cases treated before one year after exposure. The early onset of clinical symptoms requiring surgical therapy represents an acute process resulting either from massive cancercidal dose, or abnormal sensitivity to radiation. This suggests that surgical therapy for an acute radiation reaction is extremely hazardous. The simplest methods of treatment produce the lowest percentage of postoperative difficulty. If, however, these methods are re-evaluated in terms of the stage of the disease, the simpler surgical techniques are the procedures of choice before there is local tissue breakdown. But with advanced change, more complex methods of reconstruction are required and, despite their complexity and multiplicity of stages, pedicle reconstruction and block resection techniques carry a lower surgical complication rate. (H.H.D.)

35379 ROLE OF SCINTILLATION SCANNING IN DIAGNOSIS OF RENAL TUMORS. Bruce H. Stewart, Thomas P. Haynie, Mohamed M. Nofal, and Edward A. Carr, Jr. (Univ. of Michigan, Ann Arbor). J. Urol., 87: 782-9(June 1962).

An evaluation was made of scintillation scanning in 18 patients suspected of having renal tumors. Neohydrin-Hg^{203} was used in a single intravenous injection of 100 μC. The method did not differentiate between tumors and cysts, and tumors which did not appreciably replace functioning renal tissue could not be detected. In spite of these limitations, it is of value when used in conjunction with routine excretory urography. (BBB)

35380 A STUDY IN THE CONTROL OF PSEUDOMONAS AERUGINOSA IN MICE BY COLISTIN SULFATE. Edith L. Wentworth Cumming and Dennis E. J. Baker (Carworth, Inc., New City, N. Y.). Lab. Animal Care, 13: 36-40(Feb. 1963).

A specific-pathogen-free (SPF) colony of mice was developed by fostering cesarean-derived CF#1 mice on SPF-CFN rats. Fecal cultures showed none of the mice to be positive for Salmonella, or any other organisms considered to be pathogens. There was, however, a high incidence of P. aeruginosa, an organism usually present in a low incidence in conventional CF#1 mice. Because the mice appeared healthy, it was assumed that P. aeruginosa in the intestinal tract was not necessarily detrimental and that the unusual flora was perhaps a phenomenon of SPF development. After production of SPF-CF#1 mice had proceeded for some months, however, marked differences were noted in the response of these mice to radiation. X-ray doses that would kill conventional CF#1 mice in 48 to 72 hr killed the SPF stock in only a few hours. These findings were associated with the high incidence of P. aeruginosa and led to studies of ways to control, or possibly eliminate, this organism. Colistin sulfate in the drinking water significantly reduced the incidence of P. aeruginosa in these mice, as judged by cultures of intestinal contents. The reduced incidence was successfully maintained for a 20-week period. Irradiation at the end of this time, in most instances, confirmed the bacteriological findings. The percentages of infected control and colistin-treated CF#1 mice were the same before and after 800-r whole-body x irradiation. (BBB)

35381 A FAST-NEUTRON SOURCE FOR RADIOTHERAPY. R. J. Berry, R. Oliver, and E. H. Porter (Churchill Hospital, Oxford). Nature, 199: 923(Aug. 31, 1963).

Development of a 14-Mev fast-neutron source for radiotherapy was previously recommended by Lomer and Greene. Disadvantages of such equipment for radiotherapy are indicated. Among factors deterrent to such a development are: the oxygen-dependence of 14-Mev neutrons, the likelihood of adding γ contamination with the necessary collimation, and the lowering of the average linear energy transfer of the beam. (H.M.G.)

35382 INFLUENCE OF FRACTIONATION ON CLINICAL RESPONSE AND DOSAGE IN RADIOTHERAPY. J. A. C. Fleming and G. Wiernik (St. Thomas' Hospital, London). Nature, 199: 924-5(Aug. 31, 1963).

Fractionation techniques used in radiotherapy are examined, and experimental fractionation work in mice is reviewed. Results of experimentation in dose-fractionation techniques suggest that considerable improvement in clinical radiotherapy might result from adoption of curtailed techniques. Reduction of dose by 15-20% is required when the number of fractions required for a treatment is reduced from five to three a week. This conclusion is based on observations both in small and large treatment areas. The curtailed fractionation technique was eventually employed in more radical irradiation such as that for breast carcinoma. Follow-up of such cases indicates that no apparent difference exists in late radiation effects between the patients treated three times weekly and those treated five times weekly. Influence on survival times and recurrence

rates of curtailed fractionation has not been demonstrated. (H.M.G.)

35383 DIFFERENT 'SPECTRA' OF MUTANT TYPES BY EXTRA-CELLULAR TREATMENT OF PHAGE KAPPA WITH DIFFERING MUTAGENS. R. W. Kaplan, H. Beckmann, and W. Rueger (Universität, Frankfurt am Main). Nature, 199: 932-3(Aug. 31, 1963).

Plaque mutations in the phage kappa were used for comparing the type composition of forward mutations induced by extracellular treatment with eight different mutagens. Mutation types were divided into four groups and compared at about the same survival-rate after mutagenic treatment. Results showed that the total frequency of mutants per survivor is highest for hydroxylamine and lowest for hydrogen peroxide. Hydroxylamine produced fewer e mutants than HNO_2 and fewer b mutants than other chemicals. H_2O_2 gave only c mutations. Ultraviolet light induced mainly c mutations but also 29% of all other types. The x-ray-induced spectrum yielded a high proportion of e's. Spontaneous mutants showed a very particular spectrum: 95% e and very few c and b. Thus a rather special mechanism of spontaneous mutations is indicated. The results prove that intergenic or gene-group electiveness appears also in forward mutations, and that it can be caused by direct attack of mutagens on DNA without a directing action of the intercellular environment of the gene. A model for mutagen electiveness is proposed. (H.M.G.)

35384 RADIATION INJURY AND ITS SURGICAL TREATMENT. Verner V. Lindgren (Univ. of Oregon, Portland). Northwest Med., 62: 109-16(Feb. 1963).

Common types of radiation injury, particularly to the skin, resulting from radiotherapy are described and plastic surgical repair in seven cases of x-ray burns are illustrated. Few radiologists realize how common radiation necrosis is, firstly, because the patient who has been burned often does not return to the radiologist who inflicted the burn, and secondly, the serious effects, for example ulceration and malignant change, often do not occur until years after the original burn. Acute radiodermatitis is more commonly found when a rather large dose is given over a relatively short period of time. The skin reaction is primarily inflammatory, and development of carcinoma is not commonly seen in the early phase. There may be a prolonged latent period between the time of the original treatment and clinical evidence of radiodermatitis. Deformities may develop in a child following extensive radiation; severe retardation of growth produces irreversible change. It should be recognized that skin sensitivity to radiation varies greatly with different individuals, the classic example of sensitive skin being that in people with red hair. A mild dosage to the red-head's skin can frequently produce a severe reaction and damage, while the same dosage to the average person with more pigmented skin may show no effect of radiation. It is, therefore, probable that the majority of people with deeply pigmented skins may have greater natural resistance to the effects of radiation. The recommended treatment of irradiation injuries is surgical, with complete removal of diseased tissue and immediate coverage of the resultant wound, either by means of a free skin graft or a pedicle flap. The excision of all radiation lesions must be well wide of the involved area and to a depth that brings viable healthy bleeding tissue. If malignant changes are suspected, the surgeon must be certain that wide removal is obtained in all directions. Cautery must never be used for hemostasis because this causes further damage to the blood supply. Some physicians treat malignancies secondary to radiation with further radiation therapy, but this is definitely contraindicated. Different methods of closure following removal of the involved tissue are discussed. Small wounds may be closed by approximation but frequently skin grafts are indicated for coverage. Conservative treatment in radiation injuries usually fails to effect a cure. Split-thickness skin grafts are recommended on non-weight bearing areas and where no vital structures are exposed, especially in older persons. Use of pedicle flaps to repair large necrotic areas over vital structures is also described. Successful application of these techniques in seven patients is outlined. (BBB)

35385 CONSTRUCTING PHANTOM HEADS FOR RADIATION RESEARCH. Albert G. Richards and Richard L. Webber (Univ. of Michigan, Ann Arbor). Oral Surg., Oral Med., Oral Pathol., 16: 683-90(June 1963).

Construction of a phantom head, consisting of a human skull encased in plastic skin made in the shape of the human head, is described. Soft tissue was simulated effectively by filling the plastic head-shaped container with water. Plastic foam was used to exclude water from sinuses normally filled with air. The plastic portion of the foam was composed of elements of light atomic number, while light gases, which formed the voids within the bubbles, contributed most of the bulk of the foam. Roentgenograms of the foam indicated that it was extremely transparent to x radiation. Plastic skin was prepared from a mold obtained by sculpturing the phantom head. The assembled skull was first covered with aluminum foil to protect it from the molding clay used to reproduce the external soft-tissue features. Thin plastic coating was sprayed on the clay head to serve as a parting medium for subsequent preparation of a plaster cast. A sheet of transparent butyrate plastic $^3/_{32}$ in. thick and slightly larger than the mold, was heated until it softened and began to sag. It was placed over the plaster mold, and a vacuum was used to force the plastic into the contours of the plaster mold. When the excess of the plastic sheets was removed from along the profile of the formed head, the two halves of the head were cemented together along the midline. The top of the plastic head was removed to permit insertion of the skull within it, and small holes were drilled in the plastic head through which plastic rods were inserted to support and maintain the osseous tissues at definite distances from the plastic skin. The skull was soaked before insertion to prevent swelling which could break the seal of the plastic spacer rods and the plastic skin. Before use, the phantom head was filled with water containing a small amount of disinfectant. It was kept dry except when in use. (BBB)

35386 COSTAL CARTILAGE HOMOGRAFTS PRESERVED BY IRRADIATION. Reed O. Dingman and William C. Grabb (Univ. of Michigan, Ann Arbor). Plastic Reconstruct. Surg., 28: 562-7(Nov. 1961).

Use of preserved cartilage homografts in restoring contour to defects of the supporting structures of the face is described and illustrated. Adequate sterilization of contaminated cartilage is effected by Co^{60} γ irradiation for 15 hr using 3,000,000 rep. The cartilage is then stored in saline at room temperature. No pathologic organisms were cultured from a series of 70 cases in which Co^{60}-sterilized cartilage was used. Experiments in dogs, with direct measurement and inspection of 36 grafts implanted in the rectus sheath and on the pericranium, 2-12 months after transplantation, revealed that canine costal cartilage sterilized in merthiosaline gave 33.3% complete and 33.3% partial absorption, while irradiated cartilage stored in

saline gave 27.8% complete and 5.5% partial absorption. Clinical evaluation of 30 patients examined from 7 months to 3½ yr postoperatively revealed evidence of absorption only in two grafts. Techniques of preparing, sterilizing by irradiation, and storing of human costal cartilage are described. (TCO)

35387 A NEW, BATTERY-POWERED X-RAY APPARATUS GIVING AN ESPECIALLY LOW RADIATION DOSE TO THE PATIENT; PRELIMINARY EXPERIENCE. O. Hubacher (Röntgeninstitut, Thun, Switzerland). Praxis (Bern), 50: 1064-7(Oct. 12, 1961).

A new radiodiagnosis device that permits a 60% dose reduction but gives roentgenograms with detail comparable to that obtained with conventional x-ray machines is described. It is transistorized and operates on batteries, which when combined with normal 110- to 220-v supply, has a capacity of up to 200 r/2 hr. Lung pictures can be obtained at a distance of 150 cm with a 0.06-sec exposure and vertebral films with 2.5 sec. The 16-v battery permits x-ray intensities of 60 to 90 kv to be obtained at low current (10 to 25 ma). In spinal roentgenograms, film blackening and contrast were identical when this device operated, and comparison was made with a conventional device. It is suggested that this apparatus would be useful for military field operations and other conditions where high-voltage power is not feasible. (BBB)

35388 LONG-TERM EXPERIMENTS IN RELATION TO TREATMENT EFFECTS: RADIOBIOLOGICAL AND GERONTOLOGICAL PROBLEMS. A. C. Andersen and D. H. McKelvie (Univ. of California, Davis). Proc. Animal Care Panel, 12: 169-82(Sept. 1962).

The care and breeding of dogs, particularly beagles, for use in radiation research are discussed, with emphasis on the problems of housing large numbers of animals in outside pens and inside cages. Problems encountered in studying the effects of low levels of radiation on aging are also reviewed. The primary concern in such studies is to distinguish radiation-induced syndromes from normal gerontological phenomena. In such cases, evidence of radiation effect requires statistical methods when adequate numbers of animals are a prerequisite. Furthermore, types of radiations and exposure factors may manifest entirely different syndromes. Thus, radiation can be used as a tool to investigate some of the sequellae that are involved in geriatrices. The consistency of a breed aids considerably in reducing these variances, and the determination of radiation effects dictates that all genetic and environmental factors be maintained at an optimum. The described beagle breeding colonies have whelped almost 750 litters during the past 10 yr, and certain parents consistently produced a sufficient number of progeny of uniform size and conformation and even temperament, relatively free of inherited defects and moderately resistant to common ailments. Parental selection was used to improve breeding-colony production. Dams whelping 4-6 pups per litter have min (17%) puppy losses to the weaning age. Reproduction in the beagle should average 1.45 pups per dam per 100-day breeding period. The most practical means of restraining dogs in a large kennel is with outdoor pens of proper design. Normal beagles can be raised and maintained to maturity in cages that allow companionship and 12 ft^2 per dog. Inside cages were designed for the safe administration of hazardous radionuclides. (BBB)

35389 CONTINUOUS LINEAR PHOTODENSITOMETRY IN RADIODIAGNOSIS. L. Oliva and E. Pignataro (Università, Genoa). Radiol. Med. (Turin), 48: 1088-1101(Nov. 1962).

A new technique and apparatus are described that enable the recording of detailed information from diagnostic radiologic photographs that is not obtainable by visual inspection of the films. A continuously recording photometer is used to scan strips of film, giving a tracing showing variations in density of the image along the strip scanned. The technique is illustrated by application to 2-cm wide strips of lung roentgenograms. It permits, for example, detection of otherwise difficult to discern rib fractures, which show as a sharp density peak on the photometric tracing. Other occult structures such as tumors, calcifications, soft tissue areas, fat, and gas spaces can also be detected readily. Various other applications of the method are discussed and illustrated, and the use of standard tracing for comparison with those of pathologic conditions is also considered. (BBB)

35390 EVALUATION OF AN ISOTOPE CORONARY PATENCY TEST BY ANGIOGRAPHY. Harry A. Bishop (Univ. of California, Los Angeles), Albert A. Kattus, Leslie R. Bennett, and Ismael Mena. Radiology, 81: 428-36 (Sept. 1963).

The downslope of the left heart activity-time curve is more prolonged than that of a similar curve produced by the same radioactive bolus in the peripheral circulation. It is hypothecated that this relative slope prolongation is a function of coronary filling. The ratio of the exponential half periods (T1/2) of the downslopes of the left heart and brain curves is proposed as a measure of the left heart slope prolongation effect and has been called the coronary flow index (C.F.I.). This ratio was measured in 31 patients whose coronary arteries had been studied angiographically. Five patients had normal coronary arteries and 26 had occlusive disease. The C.F.I.'s of the normal subjects ranged between 1.52 and 2.20 while the range for the coronary patients was 0.94 to 1.21. Without exception, the patients with coronary occlusive disease showed a definite decrease in the left heart slope prolongation effect. The C.F.I. test is simple and takes less than ten minutes to perform. It requires, however, the accuracy of costly digital computing and recording equipment. Although the C.F.I. is essentially a qualitative test and is not a measurement of coronary blood flow per se, the results of this and previous studies suggest that it is a reliable indicator of coronary occlusive disease. (auth)

35391 CONSIDERATIONS ON THE USE OF IONIZING RADIATIONS IN MEDICINE. P. C. Roth. Rev. Pathol. Gen. Physiol. Clin., 62: 341-52(Mar. 1962). (In French)

A review. (BBB)

35392 THE IMPACT OF HIGH ENERGY IN RADIOTHERAPY. Jean M. Debois. Scalpel, 115: 1023-9 (Nov. 17, 1962). (In French)

The advantages of high-energy radiation over conventional x-ray techniques in the treatment of cancer are reviewed. (BBB)

35393 TUBES FOR IRRADIATION OF BREAST CARCINOMAS. Ljuben Minkow. Strahlentherapie, 121: 474-8 (July 1963). (In German)

The pre- and post-operative irradiation of breast cancers with tangential fields with a field size of 8, 9, or 10 × 24 cm is recommended instead of using a tube with the field size 20 × 24 cm. Using this method, almost the total radiation beam is concentrated on the area which shall be irradiated and it is centered with the central beam and not as usual by the peripheral parts of the field. Such a tube is lighter and, therefore, easier to handle. By limiting the radiation beam, the diffuse scattering of radiation in the irradiation area is decreased to less than half and, there-

fore, the general reaction of the patients also can be decreased. The narrow tube is used in all irradiation methods with great tangential fields. (auth)

35394 FAILURES AND HAZARDS IN OPERATIONS FOR DIVERTING THE URINARY TRACT IN WOMEN WITH IRRADIATED GENITAL CARCINOMA. W. Krebs and M. Mebel (Städtischen Hufeland Krankenhauses, Berlin). Wiss. Z. Humboldt-Univ. Berlin, Math. Naturw. Reihe, 12: 85-6(1963). (In German)

Among 1530 women submitted to radiotherapy for pelvic cancer, 49 (3.2%) developed serious urinary tract complications. The complications in these 49 cases could be broken down as follows: severe radiation cystitis 11, cystitis and ureteral stenosis with urinary stasis 6, bilateral ureteral stenosis and stasis 18, unilateral stenosis with stasis 7, and ureteral-, rectal-, or vaginal-vesical fistulas 7. Of 15 patients treated conservatively with bladder instillations, analgesics, and prednisone, eight were improved, six unimproved, and one died. Of 17 treated surgically by unilateral or bilateral nephrostomy, 7 were improved and 10 died. Nephrectomy led to improvement in each of the five cases so treated, and plastic surgery in only three of six cases, the other three dying. Successful repair of radiation-injured ureters in several cases is described. It is concluded that early diagnosis and treatment of urinary tract injuries following radiotherapy are essential if successful outcome is to be obtained. (BBB)

35395 STUDIES ON X-AGENT. XXI. FLUCTUATION OF X-AGENT IN ITS EFFECT ON ERYTHROCYTE-SEDIMENTATION RATES. Hideo Moriyama and Tsugi Ogasawara (Shonan Hygiene Inst., Kamakura, Japan). Yokohama Med. Bull., 13: 231-45(June 1962).

Sedimentation rates of red blood cells were found to change according to the location of the tubes containing the cells. The rates were higher, in general, on a table than under it. A similar difference was demonstrated between the inside and outside of a metallic box. This difference is explained by the assumption of a factor which was shielded by the table or the metal plate. It is postulated that X-agent represents photons ranging in energy from γ rays to thermal radiations, which are temporarily altered in character. Most of X-agent components originate from high-energy γ rays in secondary cosmic rays, and consequently have strong penetrating power. Low-energy photons, such as thermal rays, seem also to be concerned in the production of the agent, it is suggested. If X-agent is mainly derived from a component in secondary cosmic rays, there may be some correlation between X-agent and cosmic rays or solar activity. However, in November 1960, when solar activity was reported to be extremely violent, there was no distinct disturbance in the activity of X-agent. X-agent seems to progress from south to north. This tendency is explained assuming that as cosmic rays progress through the geomagnetic field, they generate the new radiation acting as X-agent. Such a situation may be attained if the earth is in a special orientation to the shower of cosmic radiation, and this situation may be dependent on the variation of the helicoidal motion of the earth. (BBB)

35396 PROCEDURE FOR MORE ACCURATE DETERMINATION OF DOSAGE IN THYROIDECTOMY WITH I-131. Georg Justus (County Hospital, Gyula, Hungary). Z. Ges. Inn. Med. Ihre Grenzgebiete, 16: 995-8(Nov. 15, 1961). (In German)

From studies of 20 patients, attempts were made to arrive at the optimal isotope dose for producing persistent hypothyroidism. When the patients were given I^{131} doses varying from 30 to 200 μC, the thyroid uptake of isotope measured at 24 hr postinjection exceeded 50% in all cases. These measurements as well as those at successive daily intervals showed that the biologic half-time value varied widely among individuals and could not be used to calculate the optimal dose. To evaluate this more closely, thyroid scintography was carried out to determine the volume of the gland, from which its wt could be calculated. Normal gland wt of 20-5 g and a density of 1.15 were verified. A glass model of the thyroid, which was filled with water containing 100 μC I^{131}, was used for comparative scanning measurements. A formula was derived for calculating thyroid wt in grams. With an estimate of thyroid wt so obtained, greater precision is possible in calculating the thyroidectomy dose. (TCO)

35397 HEMOLYSIS AND THE DEFIBRINATION SYNDROME ARISING AS COMPLICATIONS FROM THE RADIOTHERAPY OF CHRONIC LYMPHATIC LEUKEMIA. Eugen Farkass (Karolyi Hospital, Budapest). Z. Ges. Inn. Med. Ihre Grenzgebiete, 17: 597-9(July 1, 1962). (In German)

Side-effects of the radiotherapy of leukemia are described, with reference to the case history of a 68-yr-old man who developed after irradiation a hemorrhagic diathesis not a usual complication of leukemia. He received two courses of whole-body irradiation with total doses of 1800 and 1600 r as 150 daily doses. Four days after completion of the last course of therapy, massive subcutaneous bleeding was noted over the chest, abdomen, back, and upper thigh. The bleeding areas spread rapidly and became painful. Clinical and lab findings at this time included anemia, thrombocytopenia, marked reticulocytosis (all attributable to leukemia), a positive direct Coombs test, markedly increased clotting time for recalcified plasma, and abnormally low levels of prothrombin and fibrinogen in plasma. It is suggested that the deficient coagulability of blood was induced by irradiation. The hemorrhagic condition responded to treatment with ACTH, antibiotics, and blood transfusions. (BBB)

35398 COMPARATIVE DETERMINATION OF BLOOD VOLUME WITH EVANS BLUE AND Cr^{51} IN HEALTHY SUBJECTS AND POLYCYTHEMIA PATIENTS TREATED WITH P^{32}. K. W. Schneider and G. Becker (Universität, Würzburg, Ger.). Z. Klin. Med., 157: 350-71(Sept. 12, 1962). (In German)

Blood volume was determined by the Evans blue and the Cr^{51} methods in 40 normals and 17 cases of polycythemia. In normals there was good agreement of the results of both methods, however, in polycythemia differences were observed. With the Cr^{51}-method the erythrocyte volume was found to be lower than with the Evans blue technique although the difference was not significant. When the active circulating blood volume is determined, the introduction of a correction factor for the so-called body hematocrit is not necessary. It is possible that the difference between venous hematocrit and the quotient Evans blue-plasma volume/Cr^{51} erythrocyte volume is caused by an increase of the error due to the trapped plasma. In cases with increased hematocrit values the plasma volume should be determined by Evans blue and the erythrocyte volume by Cr^{51}. In polycythemia the mean values were lower than those previously estimated by Seyderheim and Lampe. In the untreated state of polycythemia the mean plasma volume is reduced; in 60% of the cases a reduction was found initially. With successful treatment the plasma volume increased. Treatment consisted of injection of 0.06-0.09 mC P^{32} per kg body wt, which was repeated three months later if necessary. Half the patients required only one such dose for remission; only one required three doses.

Improvement in plasma volume showed no correlation with the size of the spleen or the presence of hypertension. The venous pressure was normal in all cases. Circulation time was variable but showed a tendency to become shorter following treatment with P^{32}. Renal function studies are discussed. Creatinine-clearance and phenolsulfonphthalein (PSP) excretion were often reduced, and albuminuria, hematuria, and azotemia were present. With clinical improvement after P^{32} treatment these symptoms are reversible except for the reduced PSP excretion. (BBB)

35399 AUSÜBUNG DER HEILKUNDE MIT RADIOAKTIVEN STOFFEN. (The Practice of Therapy With Radioactive Substances). H. Lossen. Stuttgart, Georg Thieme Verlag, 1962. 166p. DM 16.50.

35400 CALIBRATION OF A NEUTRON SOIL MOISTURE METER. K. N. Burn (National Research Council, Ottawa). 24p. (CONF-89-4)

From International Symposium on Humidity and Moisture, Washington, D. C., May 1963.

Experience in the use of a neutron soil moisture meter in substitute media in the laboratory and in natural soils led to the discovery that actual neutron activities could differ by 11% from one to the other. The explanation for this discrepancy appears to lie in the presence in the natural soil of an element whose capture cross-section for neutrons is comparatively low but which occurs in such large quantities that the absorption of neutrons is significant. The design of a scintillation moisture meter, its calibration in the laboratory, and subsequent field assessment are described. The factors found to cause the discrepancy in instrument readings are also discussed. (P.C.H.)

35401 MEASUREMENT OF MOISTURE CONTENT OF SOIL BY RADIOISOTOPES. E. H. G. Goelen. 30p. (CONF-89-1)

From International Symposium on Humidity and Moisture, Washington, D. C., May 1963.

The problem of the continuous determination of the variation of the volumetric water content with depth by means of a neutron probe was examined. For the reliability of the measures, the geometrical conditions of and around the probe were examined. The results of the test data obtained with neutron probes with various inner set-ups with cylindrical symmetry are given and discussed. In the tests, the probe is lowered to the test point in duraluminum tubes, which are statically pushed in the ground by means of a 10-ton penetrometer. The results of some field tests are also given. (P.C.H.)

35402 NEUTRON SCATTERING MEASUREMENT OF SOIL MOISTURE: DEVELOPMENT AND CURRENT STATUS. C. H. M. Van Bavel (Water Conservation Lab., Tempe, Ariz.). 40p. (CONF-89-8)

From International Symposium on Humidity and Moisture, Washington, D. C., May 1963.

A source of fast neutrons produces a cloud of slow neutrons in a hydrogen-rich medium that is free of effective neutron absorbers. The cloud has an order of magnitude of 15 cm diameter and its density, as detected with a slow neutron counter, is an almost-linear indicator of moisture content. This principle was applied to the measurement of soil moisture content and reliable, portable equipment is available. Accuracy is from ½ to 1% moisture by volume. Though in first approximation the calibration, which must be obtained empirically, is the same for many soils, differences of importance can be attributed to the varying chemical composition of soils and their varying density. Non-water hydrogen, chlorine, and boron are the principal disturbing elements. Their effect can be accounted for. The neutron method has potential for moisture measurement and control in many organic and inorganic substances including snow. Its resolving power is limited by the penetrating nature of fast neutrons and the diffuse presence of slow neutrons. (P.C.H.)

35403 USE OF THE NUCLEAR PROBE IN STUDIES OF THE SOIL MOISTURE REGIMEN ON LYSIMETERS AND SMALL WATERSHEDS. F. R. Dreibelbis (Agricultural Research Service, Coshocton, Ohio and Ohio Agricultural Experiment Station, Wooster, Ohio). 23p. (CONF-89-3)

From International Symposium on Humidity and Moisture, Washington, D. C., May 1963.

Resistance blocks and neutron scattering equipment were used to obtain soil moisture data on watersheds 0.5 to 0.9 hectare and on monolith lysimeters 8.09 square meters in area. Measurements were made in 1.8 meter profiles of two soil types under corn, wheat, meadow, and woodland covers. The reliability of the probe and blocks was confirmed by comparing data obtained from these with data from the weighing lysimeter. Likewise, ET as determined from weight changes checked closely with ET data obtained from the probe and blocks. Soil type showed little influence in the 0-18 cm layer, the zone of major hydrologic activity, but exerted considerable influence in the lower soil layers. Agronomic practice influenced the moisture regimen more than did soil type. The contrast between different crops also had a marked effect. The possibility of extrapolating the small-area results to the field of watershed management is discussed. (auth)

Biochemistry, Nutrition, and Toxicology

35404 (BNL-6556) ON THE HORMONAL REGULATION OF CARBOHYDRATE METABOLISM; STUDIES WITH C^{14} GLUCOSE. R. C. deBodo, R. Steele, N. Altszuler, A. Dunn, and J. S. Bishop (New York Univ., New York. Medical Center and Brookhaven National Lab., Upton, N. Y.). [1962]. Contract [AT(30-2)-Gen-16]. 56p.

Glucose labeled with C^{14} was used in studies of the influence of various hormones on carbohydrate metabolism in dogs. Results are reported from investigations of the state of carbohydrate metabolism during pituitary or adrenal deficiency and during growth hormone or glucocorticoid regimes. The effects of glucagon, epinephrine, and insulin on blood glucose concentration were also studied. (C.H.)

35405 (LADC-5794) THYROID METABOLISM IN CHILDREN AND ADULTS USING VERY SMALL (NANOCURIE) DOSES OF IODINE^{125} AND IODINE^{131}. M. A. Van Dilla and M. J. Fulwyler (Los Alamos Scientific Lab., N. Mex.). [1963]. Contract [W-7405-eng-36]. 37p. (CONF-66-8)

From Symposium on the Biology of Radioiodine, Richland, Wash., June 1963.

A new technique for measuring the radioiodine content of the human thyroid in vivo with nanocurie amounts of I^{131} and I^{125} is described. The technique gives a measure of the thickness of neck tissue over the thyroid; values of 0.4 and 2.0 cm have been found in the subjects studied thus far. Results on 6 normal adults show uptake at 7 days after oral ingestion varies between 15 and 29%, with biological half times between 27 days and infinity. Results on 8

normal children (ages 4 to 10 yr) show little or no difference from adults as far as the data extend (15 days post oral ingestion). Uptakes vary between 9.5 and 27%, and biological half times are long compared to the 8-day physical half life. (auth)

35406 (TID-17965) A QUANTITATIVE METHOD FOR JACK RABBIT STOMACH CONTENT ANALYSIS. W. E. Saul and J. B. Echo (Idaho Operations Office, Health and Safety Div., AEC). [Jan. 30, 1963]. 10p.

A quantitative method is described for the analysis of the stomach contents of jack rabbits (Lepus californicus). (C.H.)

35407 (TID-19332) RADIOACTIVE ZINC-65 IN MARINE ORGANISMS IN FISHER'S ISLAND SOUND AND ITS ESTUARIES. Summary and Progress Report, December 1, 1962 through November 30, 1963. Donald M. Skauen (Connecticut. Univ., Storrs and Connecticut. Univ., Noank. Marine Research Lab.). Aug. 26, 1963. Contract AT(30-1)-2487. 35p.

Data are presented on total Zn and Zn^{65} in samples of oysters and plankton collected in the Thames River, Conn., between July 1962 and Sept. 1963. Data are included from a study of the accumulation of Zn^{65} by the Atlantic plate limpet, Acmaea t. testundinalis, and hydrographic survey of the Thames River collecting areas. (C.H.)

35408 (AEC-tr-5631) THE METABOLISM OF PHOSPHORUS AND IODINE IN DEER. J. Rerabek and A. Bubenik (Czechoslovakia). Translation of "Metabolismus Fosforu a Jodu u Cervidu," 1963. 56p.

A detailed study of the metabolism of P^{32} in antlering fallow deer and in young roebucks in the process of growth, and the retention of I^{131} in roebucks was carried out. The results showed that during antler growth ossification processes are accompanied by deposition of high doses of phosphorus in the antlers. In the body of deer there is no such storage (depot) where phosphorus could be accumulated in such an amount as to be able to supply sufficient quantities in the period when needs are high. Therefore phosphorus requirements for antler development must be primarily fulfilled by plant food intake. Phosphorus that is bound in natural organic compounds in the plant is better absorbed by the antlering fallow deer than are inorganic compounds of the element. Iodine is selectively accumulated in the thyroid when the latter is in an inactive period. Quantitative data are reported regarding the absorption and excretion of phosphorus by the digestive system. The experimental results are discussed in the context of game management and comments are made regarding prevention of phosphorus deficiency in free-living deer. (P.C.H.)

35409 THE USE OF NITROGEN MUSTARD FOR DETERMINATION OF THE BIOLOGIC ACTIVITY OF RADIOPROTECTIVE SUBSTANCES. F. Hernadi, Zs. Nagy, A. Jeney, and T. Valyi-Nagy (Medical Univ., Debrecen, Hungary). Acta Physiol. Acad. Sci. Hung., 20: 421-7(1961). (In German)

An assay method was developed, using Escherichia coli 0:111 as the test organism, which provides a simpler means of screening possible radioprotective agents than the usual radiation tests in animals. The method is based on the similar injurious effects of N mustard and ionizing radiation on cells. A 0.1 ml suspension of bacterial cells (10^5 cells/ml) are incubated in 0.5 ml pH 8 bicarbonate buffer with a 1-ml solution of the radioprotective agent to be assayed. Ten min later N mustard in 0.5 ml bicarbonate buffer (an LD_{50} dose of 300-500 μg/ml or an absolute lethal dose of ~1000 μg/ml) is added. After an additional 30 min, the suspension is diluted to 10 ml with saline, and 0.2 ml of this dilution is plated on agar culture medium. Colonies are counted and compared with the control number of 200. Under these conditions the effective doses of cysteine, cysteamine, and aminoethylisothiouronium hydrobromide were ~100 μg. Similarly, protective activity could be demonstrated for homocysteine thiolactone, glutathione, dimercaptopropanol, and serotonin. The following were inactive by this test: methionine, adrenaline, noradrenaline, histamine, reserpine, chlorpromazine, malonic dinitrile, and sodium nitrite. When these results were checked by radiation protection tests, the only compounds not showing correspondence between the two assay methods were reserpine and malonic dinitrile, which protected against x rays but not against N mustard. In spite of this discrepancy, it is suggested that the N mustard test may be used for screening purposes. (BBB)

35410 ADRENOCORTICAL RESERVE IN PATIENTS WITH GENITAL CARCINOMA. Aimo Pekkarinen and Lauri Rauramo (Univ. of Turku, Finland). Ann. Chir. Gynaecol. Fenniae., 52: 148-62(1963).

Adrenocortical reserve was measured in patients with uterine cancer to detect possible functional insufficiency of the adrenals and ascertain whether there is a correlation between that insufficiency and the stages of carcinoma, age of the patient, and radiation treatment. The 2-day adrenocortical reserve was determined in 125 patients before or after radiation treatment. Forty I.U. corticotropin (ACTH) was injected intramuscularly during two days. The mean basal daily excretion of 17-hydroxycortico steroids (17-OHCS) was 6.7 mg. It increased to 13.9 mg on the first ACTH day and to 20.7 mg on the second. In 48 patients the excretion of 17-OHCS remained at the basal level during both ACTH days, indicating insufficient adrenocortical reserve. In addition, 28 patients showed a weak adrenocortical reserve in the ACTH test. Normal or strong adrenocortical reserve was observed in 46 cases. Age had no significant influence on the adrenocortical reserve (above and under 50 yr). With different stages of carcinoma of the cervix, there was a tendency to weakened adrenocortical response in stages III and IV during the second ACTH day. Radiation therapy (300 r/day) increased the adrenocortical response, nearly two fold on the 2nd day of ACTH injection (to 26.9 mg/day compared with 14.8 in nonirradiated patients). Before irradiation, excretion of 17-OHCS on the first ACTH day was 11.8 mg and after irradiation was 14.5 mg. These differences were observed in patients both under and above 50 yr. Apparently, radiation treatment in some patients acted as a stimulus to increase adrenocortical reserve. The doses of radiation used were not large enough to have an inhibiting effect upon the adrenal cortex. (BBB)

35411 CHEMICAL PROTECTION AGAINST IONIZING RADIATION. Robert L. Straube and Harvey M. Patt (Argonne National Lab., Ill.). Ann. Rev. Pharmacol., 3: 293-306(1963).

Recent work on chemical protection against radiation effects in mammals is reviewed, especially with respect to whole-body exposure to external radiation. This survey shows that many explanations are being offered to account for the action of radioprotective agents. In general, the proposed mechanisms are concerned with inactivation of radicals and other chemical intermediates, depletion of oxygen, or alteration of target molecules. The tendency to interpret protection as a simple competition with free radicals derived from irradiated water has been decreasing in recent years. This is due, in part, to the fact that

some agents can protect nonaqueous systems, while others have strong pharmacological properties related to the protective effect. Arguments continue to be advanced for and against a connection between protection by aminothiols and hypoxia, but there is practically no information about intracellular oxygen tensions, a parameter that might give a definitive answer to this question. Various data support the conclusion that some factor other than hypoxia is responsible for the protective action. Even if some protective agents, particularly the biological amines, act by inducing a hypoxia in critical sites, it is still necessary to explain the oxygen effect. The sensitizing action of oxygen has been thought of in terms of interactions between oxygen molecules and the electrons, ionized and excited molecules, and free radicals that are found along the tracks of ionizing particles. It is suggested that interaction of oxygen with free radicals may lead to the formation of more toxic agents; oxygen interaction with ionized or excited molecules may also provoke their further breakdown. There is also the possibility that protective agents might combine with target molecules and thereby alter their sensitivity; the concept of protection by mixed disulfide formation is an example. It is concluded that a protective agent should be nontoxic with no delayed or cumulative effect, and with a relatively long duration of protective activity. The ideal radioprotectant could be conceived as a ubiquitously distributed energy trap, capable of absorbing and dissipating incident energy without damage to important biological molecules. How such a reactive entity could retain its integrity for long periods of time in the metabolically active cell is difficult to envisage, but if it were possible, protection might far exceed the factor of two in dose reduction which appears now to be the max efficiency for known agents. (BBB)

35412 HISTORADIOAUTOGRAPHIC STUDY OF THE INCORPORATION OF TRITIATED URIDINE IN TISSUE CULTURES OF NORMAL FIBROBLASTS OR THOSE SUBMITTED TO THE ACTION OF ANTIMITOTIC SUBSTANCES. M. Chevremont and E. Baeckeland. Arch. Biol. (Liege), 72: 461-84(1961). (In French)

The incorporation of uridine-H^3 was studied in chick fibroblasts cultivated in vitro by a hanging drop technique. Control cultures were treated with ribonuclease or neutral deoxyribonuclease to investigate the metabolism and synthesis of RNA in the fibroblasts, either normal or treated by some antimitotic substances, including Be. In normal fibroblasts, within a few minutes, of uridine-H^3 addition, the nucleus, mainly the nucleolus, appears to be radioactive. A part of the newly synthesized RNA of the nucleolus is transferred to cytoplasm. After a long period of contact with uridine, the nucleoli are very strongly labeled (RNA), the rest of the nucleus only moderately (RNA and DNA), and the cytoplasm heavily (RNA). Thus, these studies showed that active synthesis of RNA takes place inside the nucleus, and any synthesis eventually occurring in the cytoplasm is relatively weak or slow, indicating that at least a part of the cytoplasmic RNA originates from the nucleus. The synthesis of RNA continues during the preprophasic period of DNA synthesis and during the postsynthesis period. Beryllium, added at concentrations of 0.0025 to 0.0125 M, inhibited incorporation of uridine into nucleus, particularly into nucleolus. This was noted at 4 and 24 hr after addition Be; no difference was noted in the effects of the two concentrations tested. Ribonuclease, added to living cultures, reduces the amount of tritiated uridine in the nucleus and cytoplasm. Trihydroxy-N-methylindole has no effect in this respect. (BBB)

35413 GENERAL PHARMACOLOGIC ACTIVITY AND ANTITOXIC PROPERTY OF DIMERCAPTOSUCCINIC ACIDS. I. MESO-2,3-DIMERCAPTOSUCCINIC ACID (DTS, DMS, RO 1-7977). A. Cannava and F. Curgurra (Università, Sassari, Italy). Arch. Intern. Pharmacodyn., 131: 283-300(1961). (In Italian)

The ability of meso-2,3-dimercaptosuccinic acid substance to chelate heavy metal ions and its radioprotective activity were tested in mice, rabbits, and dogs. In acute toxicity experiments, the LD_{50} of DMS after subcutaneous injection in mice was 1725 mg/kg, and 2700 mg/kg was fatal to rabbits after intravenous injection, indicating its relatively low toxicity. Injected intravenously in dogs, it produced an initial hypertensive and a later hypotensive phase. This was accompanied by a similar biphasic changes in respiratory activity, an initial increase in amplitude followed by a decline below the basal value. The electrocardiogram showed a transitory bradycardia after its injection in dogs. It did not antagonize the vasoactivity of adrenaline or 5-hydroxytryptamine. DMS inhibited the formation of methemoglobin caused by ferricyanide. It acted as an antidote when given parenterally to animals poisoned by As, Hg, and Pb, and in analogy with other dimercapto compounds such as BAL, it may be of value in poisoning from Sb, Au, Bi, U, and Y. It was tested for radioprotective activity in mice exposed to 700-r, whole-body x irradiation. DMS was injected intraperitoneally as the Na salt in a 200-mg/kg dose before irradiation. In the 2 groups of 10 mice each that were tested, DMS did not appreciably influence survival time, but it is suggested that further trials of its possible radioprotective activity be made using larger numbers of animals and other assay techniques. (BBB)

35414 THE INFLUENCE OF VARIOUS RADIOPROTECTIVE AGENTS ON THE TOXICITY OF ETHYLENEIMINOBENZOQUINONE (BAYER E 39). R. Koch and F. Schmutz (Universität, Freiburg i. B.). Arch. Intern. Pharmacodyn., 133: 116-26(1961). (In German)

Previous results of the inhibitory effects of a large number of radioprotective agents on alkylating agents and radiomimetic drugs are reviewed and tabulated, and experiments are reported on the influence of radioprotectants on the toxicity of the alkylating agent Bayer E 39 (2,5-bis[ethyleneimino]-3,6-bispropoxy-1,4-benzoquinone). Mice were injected with the radioprotectants 5 to 10 min before LD_{50} amounts of Bayer E 39. No significant protection was obtained with 3 mg cysteamine, 12 mg BAL, or 5 mg 5-mercaptopyridoxine. A slight protective effect was noted after pretreatment with 1 mg serotonin creatinine sulfate. The results confirm previous findings that sulfhydryl groups do not block the action of ethyleneimino alkylating agents. (H.H.D.)

35415 INFLUENCE OF SOME RADIOPROTECTANT AGENTS ON THE ENZYME SYSTEM OF HEPATIC MICROSOMES DEGRADING HEXOBARBITAL. Alexandra Thomou, C. Liebecq, and Z. M. Bacq (Université, Liège). Arch. Intern. Pharmacodyn., 142: 271-3(Mar. 1, 1963). (In French)

Tests were conducted on a preparation of rat liver microsomes which contain an enzyme system catabolizing barbiturates that requires the presence of oxygen and nicotinamide adenine dinucleotide (NAD). Assay of radioprotectants on this system was prompted by the previous unpublished finding that cysteamine prolonged barbiturate anesthesia. Oxidation of hexobarbital in rat liver homogenate, freed of mitochondriae and nuclei by 10-min centrifugation at 15000 g, at 37°C, and pH 7.4 was inhibited

~50% by 1.5 mM cystamine or 1 mM 5-hydroxytryptamine. Histamine, at 2 to 3 mM, produced not more than 30 to 35% inhibition, and higher concentrations were even less inhibitory. Cysteamine was only about 1/5th as inhibitory as cystamine, and this inhibition could be traced to its reduction to cystamine. In comparison, β-diethylaminoethyl diphenylpropyl acetate (SKF525-A), a selective inhibitor of this microsomal enzyme system, at 0.2 mM caused 80 to 85% inhibition. None of the substances tested interfered with the reduction of NAD in the presence of glucose-6-phosphate dehydrogenase, which is obtained in the soluble fraction of liver homogenate after centrifugation for 60 min at 105000 g. The microsomes catalyzed the reoxidation of reduced NAD by atmospheric oxygen, and this reaction was not inhibited by SKF 525-A after 6 min incubation. However, after 10 min, ~45% inhibition was noted. It was also inhibited by cysteamine and 5-hydroxytryptamine, to a similar extent by 1 and 5 mM concentrations, respectively. Cysteamine was only inhibitory after 15-min incubation, probably because of its prior conversion to cystamine. Histamine had an initial stimulatory and a final inhibitory action. It is concluded that the inhibitory action of radioprotective agents on this enzyme system is responsible for their prolongation of barbiturate anesthesia and that this effect is manifested via their inhibition of the reoxidation of reduced NAD. (BBB)

35416 IN- AND OUTFLUXES OF Ca IONS IN FRESHWATER GASTROPODS. O. Van Der Borght (Centre d'Étude de l'Energie Nucléaire, Mol, Belg.). Arch. Intern. Physiol. Biochim., 71: 46-50(Jan. 1963). (In English)

The uptake of Ca^{45} by the freshwater snail Lymnaea stagnalis is described. Most of the incorporated radioactivity was found inside the outer border of the shell; very little exchange or adsorption of Ca^{45} could be demonstrated with empty shells incubated with the ion. Maximum Ca^{45} uptake was noted at 17 hr; after that time the snails lost radioactivity. Similar results were obtained with other freshwater gastropods (Planorbis corneus and Lymnaea palustris). Experiments with Sr showed that it is taken up by gastropods in a manner analogous to that of Ca. (BBB)

35417 HEPATIC DAMAGE BY RETICULOENDOTHELIAL INTERFERENCE. Edwin R. Fisher and Bernard Fisher (Univ. of Pittsburgh). Arch. Pathol., 75: 191-5 (Feb. 1963).

During an investigation of the effect of reticuloendothelial system (RES) interference on the incidence and growth of induced hepatic metastases of Walker 256 carcinoma in Sprague-Dawley rats, it was observed that blocking doses of India ink and Thorotrast (stabilized ThO_2) produced an increase of hepatic metastases associated with elevations of serum glutamic-oxalacetic (SGOT) and glutamic-pyruvic (SGPT) transaminases. It is thus suggested that the effect of these agents on the incidence of hepatic metastases might not necessarily be related to inhibition of a particular RES function but to liver damage. To test this possibility, blockade of the RES with Proferrin (saccharated iron oxide) in rats and Proferrin, carbon, and Thorotrast in rabbits was carried out. Such blockade caused elevation of SGOT and SGPT, but stimulation of RES in rats with endotoxin resulted in elevation of SGOT and decrease in SGPT and was without effect on these enzymes in rabbits. Proferrin in stimulating doses produced elevation of SGOT in rats and rabbits and a decrease in SGPT in rabbits. RES stimulation with BCG produced elevation of SGOT and SGPT in rats but only SGOT in rabbits. Although overt hepatic necrosis was not evident in histologic sections of livers from animals exhibiting changes in SGOT and SGPT, an increase in mitoses of parenchymal cells was apparent. Lung, myocardium, adrenals, and skeletal muscle did not reveal morphologic change. Changes in SGOT and SGPT seem to reflect hepatic parenchymal cell damage, and it is unlikely that the damage is related to altered hepatic blood flow resulting from sinusoidal compression, although the latter was conspicuous following the use of colloidal agents in either blocking or stimulating doses. (BBB)

35418 EXTENT OF STRONTIUM SUBSTITUTION FOR CALCIUM IN HYDROXYAPATITE. Hazel P. Schoenberg (Tem-Pres Research, Inc., State College, Penna.). Biochim. Biophys. Acta, 75: 96-103(July 23, 1963). (In English)

An x-ray-diffraction technique for the analysis of Ca and Sr in calcium–strontium hydroxyapatite solid solutions is described. Solid solutions representing the complete compositional range from calcium to strontium hydroxyapatite were prepared by hydrothermal treatment of end member mixtures and by coprecipitation from solution. The influence of the cation:phosphorus ratio of precipitating solutions upon the discrimination against strontium in the precipitates was studied and the relationship to Sr adsorption by bone discussed. (auth)

35419 TRACE METALS AND THE BRAIN: THEIR CONTRIBUTION TO THE STUDY OF CERTAIN NEUROLOGICAL DISORDERS. Cyril B. Courville, R. E. Nusbaum, and E. M. Butt (Los Angeles County Hospital, Los Angeles). Bull. Los Angeles Neurol. Soc., 27: 99-103(Sept. 1962).

Strontium and other trace metals were determined by emission spectroscopy in 18 brains from humans with degenerative diseases. The cortex and white matter of the right occipital lobe were used to compare the trace metal content of the nervous tissues with other organs of the body, and to determine a base line for the amounts of trace metals (Pb, Fe, Mn, Cu, Zn, Mo, Co, Ag, Cr, Cd, Ba, and Sr) present in these areas. Specimens were taken also from the brains of normal adults between the ages of 25 and 50 yr. Alterations in amounts of trace metals in Huntington's chorea was disclosed in a study of three cases, which also showed that an interrelation between two or more of these elements may be a necessary prerequisite to the causation of some diseases. In this disease, affecting predominantly the corpus striatum, although alterations in the cerebral cortex are present, there was an increase in Sr with a decrease in Cu. A reversed situation regarding Cu metabolism was shown in another disease of the corpus striatum: there is an increased Cu content in hepatolenticular degeneration. This suggests possibly that the increased amount of Cu in the tissues favors an increased activity of the cellular elements in the lenticular nucleus, while a decrease in Cu leads to the development of the choreiform movements. The demonstration of small quantities of toxic metals (i.e., Pb and As) in the brains of some individuals suggested the possible ingestion of these metals. A definite increase was seen in Pb poisoning with encephalopathy. In one case of chronic Pb poisoning, tested by the spectrochemical method, the Pb content was 1.35 mg/100 g dry tissue, as compared to a normal value of 0.31 ± 0.04. Of special interest was the variation of Pb concentration from one part of the brain to another, and the different concentrations in symmetrical areas of the 2 hemispheres. This raises the question whether some areas of cortex, basal ganglia, and centrum have a greater affinity for trace metals than others. There was no correlation between cortical areas of known function and the amounts of trace metals in the tissue. Rather, in the case of some metals (i.e., Cu, Fe, Pb), the amounts are related to the

composition of the tissues (gray matter vs white matter). With some (i.e., Sr) the amount of deposition seemed to be the same in both types of tissue. In others, a difference was noted between the amounts deposited in the gray matter of the cortex and the amounts in the basal ganglia. The differences noted in the amounts of trace metals in comparative areas of different individuals was not dependent upon age or metabolic state, but seemed to be greater in infants than in adults. This suggests that in early life there is considerable divergence in degree of depositions, a process which becomes stabilized in later years. In some metals (i.e., Sr, Fe) the concentrations showed small variation, while in others (i.e., Zn, Cd) there was wide divergence. It is concluded that the increase of Sr in brain in Huntington's chorea is of probable significance and may serve as a marker of this disease. (BBB)

35420 RADIOISOTOPES IN THE STUDY OF BONE. Franklin C. McLean and Ann M. Budy (Univ. of Chicago). Clin. Orthopaed., No. 24, 178-97(1962).

The use of two groups of radioisotopes in bone research is discussed: the alkaline earth elements, such as Ra and Sr, which are taken up like Ca in centers of growing bone; and rare earth elements, such as Y and Pu, which are stored in bone. The physiologic factors underlying uptake of this second group are not understood, and their uptake is much less affected by age than is that of the alkaline earths. P^{32} has also been employed in studies of phosphate binding to collagen in bone. The sequence of events in calcification is best observed by the use of Ca^{45}. Administration of Ca^{45} in the living animal is followed by its deposition in osteons, newly formed as a part of the internal remodeling of compact bone. Here there is discrete radioactivity, demonstrable by autoradiography within minutes after parenteral administration of the isotope, and quickly assuming the appearance of hotspots. In addition to Ca^{45} as an indicator of the mineralization of bone, Ca^{47} and Sr^{85}, both γ emitters, are widely used and have the advantage of applicability to external counting. They are thus suitable for recording gross, over-all distribution in the skeleton and may be used in man as well as in experimental animals, since they do not require biopsy or sacrifice of the subject. Phosphous-32, which is deposited in the bone mineral as phosphate, was the first radioisotope to be applied to the study of bone, but now it has been largely replaced by the isotopes of Ca and Sr. Carbon-14 has been used to demonstrate the deposition of carbonate in the bone mineral, but results so far have been limited mainly to estimation of the biologic half-life of this element in bone. More fruitful has been the use of Na^{22} or Na^{24}, since 46% of the total body Na is present in the mineral substance of bone. In observations made 4 to 6 weeks after injection of Na^{22}, there was concentration of the radioisotope in osteons in which bone mineral was being deposited at the time of injection; this is evidence for deposition of new Na during initial mineralization. After immersion in a solution of $Na^{22}Cl$, compact bone was found to be uniformly labeled. From a study of the turnover of Mg^{28} in man, it was concluded that there is a relatively large pool with a slow turnover rate, presumably made up largely of the Mg of bone. When Zn^{65} is injected, it is initially deposited in soft tissues, but a large proportion is transferred to the skeleton, where it is held for long periods of time. Zn^{65} emits β and γ rays and has a half-life of 245 days; it thus presents a potential biologic hazard. Zn^{65} in young monkeys was found from autoradiograms made after 5 days to be exclusively located at the line where preosseous tissue is becoming mineralized. Because of its β radiation, Zn^{65} is suitable for autoradiography; its γ emission suggests its use in external counting. The usefulness of F^{18} in the study of bones and teeth is limited by its short half-life (~ 110 min). However, by use of methods for rapid isolation and purification of F^{18}, combined with a rapid method for sectioning of whole frozen animals, it is possible to obtain excellent autoradiograms, demonstrating the isotope in bones and teeth. The bones take up F^{18} within a few minutes following intravenous injection; this is mainly in the zones of mineralization; uncalcified cartilage shows no affinity for F^{18}. The localization of Ra and Pu in bone mineral is described, and the use of S^{35}, H^3, and C^{14} labeled substances to investigate metabolism of organic constituents of bone is discussed. (BBB)

35421 STRONTIUM-90 BALANCES IN MAN. Herta Spencer-Laszlo (Veterans Administration Hospital, Hines, Ill.), Joseph Samachson, Edward P. Hardy, Jr., and Joseph Rivera. Clin. Sci., 24: 405-12(June 1963).

Metabolism of Sr^{90} of dietary origin was studied under controlled metabolic and dietary conditions in 12 student nurses during a relatively high Ca intake. No Sr^{90} was administered, other than that present in the diet, which was assayed by low-level β counting of the Y^{90} daughter product. Sr^{90} content of urine and stool was also determined by low-level counting. Balances of Sr^{90} and of Ca were measured on 6-day pools of urine, stool, and on aliquots of the diet. The Sr^{90} content of milk was higher in December 1959 (11.4 $\mu\mu$c/day, or per 960 ml) than in the subsequent 5 months (9.3 $\mu\mu$c from January to May 1960) and was lowest in June 1960 (8.5). Sr^{90} content of milk had decreased in March 1961 (6.2). Sr^{90} content of the total daily diet exclusive of milk was constant from December 1959 to June 1960 and ranged from 3.5 to 4.3 $\mu\mu$c/day. The Sr^{90}/Ca ratio of the diet was higher than that of urine in all persons studied except one. Average dietary Sr^{90}/Ca ratio of all volunteers was 1.12, while the urinary Sr^{90}/Ca ratio was 0.94. The fecal Sr^{90}/Ca ratio was higher than that of urine in 10 of 12 subjects and averaged 1.49. The average percent absorption expressed in percent of the dietary intake was considerably higher for Ca (40.8%) than for Sr^{90} (15.8%), and the average absorption ratio of Ca/Sr^{90} was 2.58. The average urinary Sr^{90} excretion represented 9.1% of the average Sr^{90} intake. A significant correlation was noted between the urinary excretion of Sr^{90}, expressed in percent of the intake, and the urinary Ca excretion; however, correlation between balances of Ca and Sr^{90} was not significant. The urinary Sr^{90} excretion of 10 other volunteers of similar age who received a low-Ca diet without the addition of milk was about $\frac{1}{3}$ the value for the present group. The results were in good agreement with data obtained with tracer doses of Sr^{85} in man. The major portion of Sr^{90} contained in food passed through the intestine, and on an average only 16% of the dietary Sr^{90} intake was absorbed. At the time of this study the average Sr^{90} intake in New York City was similar to that of the analyzed diet, so that these volunteers may be representative of the general population in this age group (18-21 yr). (BBB)

35422 AUTORADIOGRAPHIC INVESTIGATION OF THE MITOTIC CYCLE IN THE BONE MARROW CELLS OF MICE. A. I. Zosimovskaya (Inst. of Radiation and Physico-Chemical Biology, Academy of Sciences, USSR). Dokl. Akad. Nauk SSSR, 151: 687-90(July 21, 1963). (In Russian)

The duration of the mitotic cycles of the hematopoietic cells must be determined both under normal conditions and while the system is exposed to various actions, in order to gain an understanding of the nature of the pathological processes taking place in the bone marrow and to take the

required protective measures. For this reason, the duration of the erythropoietic and myelopoietic cycles was determined individually. Male mice were injected with a 2.5 curie/mmole H^3-thymidine physiological solution at the dose rate of 20 microcurie/0.1 ml of physiological solution per mouse. The animals were killed at intervals ranging from 1 to 36 hours after the injection. Autoradiograms were prepared with the extracts from the femural bones, using liquid emulsions and exposure periods of 65 days. On the basis of the autoradiograms, the number of labeled cells and labeled mitoses per 5000 myelic and 5000 erythroid cells was calculated. The results indicated that the hematopoietic system reaches a steady state during which the newly formed and the dying cells are in equilibrium. The duration of mitotic cycle of the myeloid cells was estimated at 20.4 to 21.5 hours, that of the erythroid cells at 14.3 to 14.5 hours. (TTT)

35423 ELECTRON MICROSCOPIC AUTORADIOGRAPHY OF THE METABOLISM OF ^{125}I IN THE THYROID GLAND. Olga Stein and J. Gross (Hebrew Univ., Jerusalem). Exptl. Cell Res., 31: 208-11(June 1963).

Twenty-four hours after the administration of I^{125} to iodine-deficient mice, the autoradiographic localization of the isotope was determined at the electron microscopic level. Resolution appeared to approach 0.1 μ. In addition to labeling in the colloid, intracellular vesicles containing I^{125} were demonstrable. It is suggested that this appearance indicates absorption of colloid during the course of thyroid hormone secretion. (auth)

35424 RADIUM AND RADON RETENTION IN MICE. Charles W. Mays, Terence H. Cochran, and Webster S. S. Jee (Univ. of Utah, Salt Lake City). Health Phys., 9: 615-19(June 1963).

Female mice were injected intravenously with Ra^{226} at an average age of 68 days. Radium retention decreased from about 70% at 1 day after injection to about 14% at 1 yr. The ratio of retained Rn/retained Ra increased from 0.11 at 1 month to 0.18 at 1 yr. (auth)

35425 STRONTIUM–CALCIUM DISCRIMINATION IN RATS FEEDING ON RICE, MILK AND COMMERCIAL DIETS. Ryushi Ichikawa and Yoshikazu Enomoto (National Inst. of Radiological Sciences, Chiba City, Japan). Health Phys., 9: 717-20(July 1963).

The influence of rice intake in quantity on the value of the strontium–calcium observed ratio between bone and diet was investigated by a comparison of the $OR_{bone\text{-}diet}$ value among rats feeding on rice, milk, and commercial diets. The $OR_{bone\text{-}diet}$ value for the rice diet groups was close to that for the milk diet groups and significantly higher than that for the commerical diet group. The discrimination factor in gastrointestinal absorption showed a similar interrelation as that seen in the case of the $OR_{bone\text{-}diet}$ value among the diet groups. The large amount of rice intake does not seem to account for the low value of $OR_{bone\text{-}diet}$ observed in Japan. (auth)

35426 STRONTIUM AND ITS RELATION TO CALCIUM METABOLISM. F. Bronner, J.-P. Aubert, L. J. Richelle, P. D. Saville, J. A. Nicholas, and J. R. Cobb (Hospital for Special Surgery, New York). J. Clin. Invest., 42: 1095-1104(July 1963).

Studies are reported in which Ca^{45} and Sr^{85} were injected intravenously into the same individual before and after treatments thought to affect Ca metabolism, and a method is proposed for expressing results that is independent of the scheme of either Ca or Sr metabolism, but that allows a quantitative comparison of the metabolic behavior of these nuclides. To avoid making any assumption concerning a Sr pool in the presentation of the data, each of the body processes (over-all loss, urinary excretion, fecal excretion, and bone uptake) is expressed in terms of its characteristic rate constant. A comparison of the Sr and Ca rate constants of the various process in 15 studies done on eight patients whose Ca metabolism differed widely revealed that these elements were not equivalent in any of these processes. Thus, in neither over-all loss, urinary excretion, fecal excretion, nor bone uptake was it possible to establish a ratio of the corresponding rate constants that varied only within the limits of error of the mean ratio. It was not possible to establish a significant correlation (by means of regression functions) between the corresponding rate constants calculated for each element. Whereas the mean values of the total and urinary rate constants of Sr differed significantly from the corresponding Ca constants, the fecal and bone rate constants of the two elements did not so differ. Values for individual patients of these latter two rate constants appear as if distributed by change within the experimental range, with the result that the mean ratios of the rate constants of the two elements approach unity. It is concluded that, qualitatively, both Sr and Ca follow the same metabolic pathways, and quantitatively, the use of Sr as a tracer for Ca in a given individual leads only to an approximation of the true value, the degree of error varying unpredictably for a particular case. (BBB)

35427 STUDIES ON THE DISTRIBUTION OF P-32 IN RADISH. H. S. Kim (Dong Kook Univ., Korea). J. Nucl. Sci., 2: 119-21(1962). (In Korean)

Distribution of P^{32} in a pot-grown plant of the radish was studied by means of fertilization with phosphate labeled with P^{32} followed by autoradiography of the dried parts. An accumulation of P^{32} occurred in the growth point, root of hair, younger leaves, and top of leaves in the radish similarly to other plants. The activity was too low to monitor in the yellow leaves of the radish. P^{32} absorbed by the root in the radish was transported through the xylem of the radish tissue. (auth)

35428 THE DISTRIBUTION OF Rb^{86} AND Cs^{134} IN SOME TISSUES OF THE DOG AFTER INTRAVENOUS INJECTION, WITH SPECIAL REFERENCE TO RENAL UPTAKE. J. P. Blandy, L. A. W. Kemp, H. D. Ritchie, and R. Sear (London Hospital). J. Physiol. (London), 166: 46-7(Apr. 1963).

Decay studies on Rb^{86} revealed the presence of an impurity with a long half-life. Pulse height analysis established that this was due to contamination with Cs^{134}. It was subsequently confirmed by the Radiochemical Centre (Amersham) that up to 2% contamination with Cs^{134} might be present at the time of delivery of the isotope, under which circumstances, at 2 weeks after delivery 40% of the emission detected would be coming from the contaminant. Since Rb^{86} was being used with external counting for differential renal blood flow studies in man, it seemed possible that this might affect the accuracy of the results. Consequently studies were carried out to investigate tissue distribution of these isotopes after intravenous injection in the dog. Rb^{86} or Cs^{134} was given intravenously to dogs, and at intervals of 1-30 min the animals were killed, immediately after clamping the great vessels in the lower chest. Activity per g of kidney, liver, spleen, muscle, and blood was determined as a fraction of the dose injected. One kidney was exposed, and with a heavily shielded scintillation counter, counts were taken at 15-sec intervals after injection of Rb^{86} or Cs^{134}. Curves were obtained to provide a comparison of the variation with time of the con-

centration of these isotopes in kidney. The concentrations of Rb and Cs in the liver, spleen, and muscle were similar during the 30 min following intravenous injection. Max renal uptake of Rb occurred at 1-2 min and of Cs at 10-20 min, when their respective concentrations in the kidney were of the order of 10 times those in the other tissues measured. Blood concentrations of Rb had fallen to tissue levels at 1-2 min, while blood Cs concentration at this time was still as high as that in the kidney. These studies show that Cs contamination of Rb in the degree noted would significantly reduce the accuracy of the method. Cs-free Rb was later made available, and newer findings suggest that differential renal blood flow studies using this purer isotope are valid. (BBB)

35429 EFFECTS OF HISTOLOGIC AND HISTOCHEMICAL PROCEDURES ON THE INTENSITY OF THE LABEL IN RADIOAUTOGRAPHS OF CELLS LABELED WITH TRITIATED COMPOUNDS. Renato Baserga (Northwestern Univ., Chicago) and Walter E. Kisielski. Lab. Invest., 12: 648-56(June 1963).

The effects of tissue preparation and extractive procedures on the intensity of radioautographic labeling in terms of mean grain count per cell in cells labeled with tritiated precursors of proteins or nucleic acids were investigated. Ehrlich ascites tumor cells were labeled in vivo with one of three tritiated compounds (thymidine, cytidine, or leucine) and, after 30 min, were examined by radioautography. Both Carnoy's solution and absolute methanol proved to be reliable fixatives, removing from cells equal amounts of radioactivity. This fixative-soluble radioactivity presumably represents the fraction of precursor that has not been incorporated into nucleic acids or proteins. Treatment with ribonuclease (RNase) or cold perchloric acid (PCA) removed all radioactivity from cells labeled with tritiated cytidine, a precursor of RNA, but not from cells labeled with tritiated thymidine. Extraction in 10% PCA in the cold for 12 to 18 hr gives results comparable to those obtained with RNase, but cells treated with PCA looked better morphologically than cells digested with RNase. Considering that PCA extraction is a much simpler procedure than RNase digestion, PCA extraction as the method of choice for the removal of RNA is proposed. Treatment with deoxyribonuclease removed radioactivity incorporated into DNA, but it also affected to a lesser extent the RNA label. Earlier observation is confirmed that in smears of cells labeled with radioactive leucine the RNA precursors, grains found over the nucleus are not necessarily due to radioactivity incorporated into the nucleus. With leucine, almost half of the grains found over the nuclei of cells in smears are due to radioactivity present in the thin coat of cytoplasm above the nucleus. (BBB)

35430 THE BINDING OF MERCURY (Hg^{203}) BY ANIMAL TISSUES IN VITRO. A. Kleinzeller and K. Janacek (Microbiological Inst., Czechoslovak Academy of Science, Prague). Physiol. Bohemoslov., 11: 285-93(1962).

The uptake of Hg^{203} as $HgCl_2$ by various animal tissues at 0° was studied. Kinetics of Hg^{203} uptake by rabbit kidney cortex slices are described. A direct relation was shown to exist between the binding of Hg^{203} by kidney cortex slices at 0° and the resultant swelling of the tissue. N-ethylmaleimide did not markedly affect the binding of Hg^{203} by kidney cortex slices. Slices of brain cortex, liver, and also diaphragm muscle and frog skin take up considerable amounts of Hg^{203} from ice-cold saline. In brain cortex and frog skin the uptake of Hg was accompanied by an increased swelling of the tissues, while no increased swelling was found with liver and diaphragm. Hg^{203} which had been taken by kidney slices could be removed by incubation with 2,3-dimercapto-1-propanol (BAL) and more slowly by cysteine, both at 1 mM concentrations. (BBB)

35431 ON THE UPTAKE OF RADIOACTIVE PHOSPHORUS BY THE ORGANS OF THE SCORPION BUTHUS QUINQUESTRIATUS H.E. Ezz El-Din Said and Mohammed Abd-El-Khalek Mahrous (Ain Shams Univ., Cairo). Proc. Egypt. Acad. Sci., 25: 29-32(1960).

The uptake of P^{32} by various organs of the scorpion was estimated. The organs of digestion, absorption, and reproduction were found to be the most active in taking up P^{32}. However, P^{32} is not suitable for labeling scorpion venom. Data are tabulated. (P.C.H.)

35432 GAMMA-EMITTING RADIONUCLIDES IN NEWBORNS, INFANTS, AND CHILDREN. N. S. MacDonald, D. L. Hutchinson, D. L. Moyer, and R. A. Chez (Univ. of California, Los Angeles). Science, 141: 1033-5(Sept. 13, 1963).

During the period April 1962 to April 1963, 28 newborn infants, 7 stillborns, and 21 children from 4 to 15 yr of age were examined for emission of γ activity in a low-background, high-sensitivity, total-body counting facility. The 21 children contained traces of combined Zr^{95} and Nb^{95}, $Ru^{103, 106}$, and Cs^{137} in addition to the normal K^{40}. The greatest concentration of Cs^{137} observed was 80 pC/kg of body weight, or about 4% of the natural K^{40} radioactivity. Four of the seven stillborns, each counted for 10 hr, showed K^{40} and traces of Zr^{95}, Nb^{95}, and $Ru^{103, 106}$. The ratios of Zr^{95} to Nb^{95} were lower in the stillborns than in their placentas which suggested placental discrimination against Zr^{95}. The ratios of Cs^{137} to K^{40} were lower in infants than in children or adults. Thyroid glands obtained at autopsy from 24 infants during April to September 1962 contained no detectable radioiodine (less than 30 pC). (auth)

35433 AN INVESTIGATION OF THE USE OF RADIOACTIVE SUBSTANCES FOR THE DETECTION OF INFECTION. S. Frank Redo, William A. Barnes, and Jeffrey Wenig (New York Hospital-Cornell Medical Center, New York). Surg. Forum, 12: 30-2(1961).

Methods employing radioiodinated serum albumin and Na^{24}, injected intravenously, for detection of abscesses were investigated. It was shown that albumin-I^{131}, but not Na^{24}, is selectively taken up by an inflamed region, in this case produced in guinea pigs by injection of turpentine. (BBB)

35434 DEPOSITION OF STRONTIUM-90 IN BONE AND ITS NEUTRALIZATION BY PROMOTION OF CALCIUM METABOLISM ACCORDING TO THE GENERAL THEORY OF OXYGENATION OF THE PERIPHERAL CIRCULATION. E. Szirmai and O. Joklik. Z. Ges. Inn. Med. Ihre Grenzgebiete, 17: 457-9(May 15, 1962). (In German)

The present human burden of Sr^{90} originating from fallout is discussed, and means of preventing excessive accumulation and for stimulating elimination of deposited Sr are presented. On the basis of Szirmai's previously postulated concepts, increased Sr elimination from skeletal deposits will follow augmented Ca metabolism. It is proposed that Ca turnover may be enhanced by increased oxygenation of the tissues and the accompanying improvement of peripheral circulation. This in turn is stimulated by better pulmonary ventilation. Under these conditions the proportion of circulating Ca in the ionized form is increased, and the rate of Sr deposition in bone decreased. Nutritional balance, especially adequate intake of vitamins B_1, B_6, B_{12}, and C, also favors ionization of circulating Ca.

Extensive Sr contamination of humans may be treated in part by techniques and drugs, such as tolazoline, which increase the peripheral circulation. (BBB)

35435 SERIAL OBSERVATIONS OF THE ABSORPTION AND WHOLE BODY TURNOVER OF CALCIUM 47. Pammi Bevli and Milton E. Rubini (Univ. of California and Veterans Administration Center, Los Angeles). 5p. (CONF-65-7)

From Federation of American Societies for Experimental Biology 47th Annual Meeting, Atlantic City, Apr. 1963.

The absorption and whole-body turnover rates of Ca^{47} in rats and mice over a period of rapid body and skeletal growth are reported. The data indicate that with a 5 to 6 fold increase in size, increased rate of Ca turnover is associated with a progressive rejection of dietary Ca. (P.C.H.)

Fallout and Ecology

Refer also to abstracts 36006 and 36007.

35436 (BNL-6408) RESEARCH ON THE EFFECTS OF IONIZING RADIATION ON TERRESTRIAL ECOSYSTEMS. George M. Woodwell (Brookhaven National Lab., Upton, N. Y.). [1962]. Contract AT-30-2-GEN-16. 24p.

The biological effects of various doses of radiation in plants are reviewed. Data are reported from a study of the effects of γ radiation on a terrestrial ecosystem in which oak and pine are the principal tree species. Exposure rates around a 9500-C Cs^{137} source varied from several thousand r/day within a few meters to about 2 r/day at 130 m delivered during a 20-hr day. Measurements were made of changes in the populations of species which formed the ecosystem, the rates of fixation, paths of energy movement through the system, differences in radiosensitivity among the plant species, and radiation effects on host-parasite relations. Results are discussed from the standpoint of the results of contamination of the environment with radioactive debris. (C.H.)

35437 (TID-17977) ABOVEGROUND PLANT PARTS AS A PATHWAY FOR ENTRY OF FISSION PRODUCTS INTO THE FOOD CHAIN WITH SPECIAL REFERENCE TO Sr^{89-90} AND Cs^{137}. M. J. Bukovac, S. H. Wittwer, and H. B. Tukey (Michigan State Univ., East Lansing). [1962]. Contract [AT(11-1)-888]. 52p.

Paths by which fission products may enter the human diet are reviewed with emphasis on mechanisms of absorption and distribution by aboveground plant parts. Results are presented from a number of tracer studies on the absorption and subsequent distribution in plants of fission products deposited on fruits, leaves, and stems, the recovery of Sr^{90} and Cs^{137} in fruits and seeds following foliar application, the comparative absorption of Sr^{89} by various plant species, redistribution of absorbed fission products during plant development, and the loss of fission products from leaves and fruits by leaching by rainfall. (74 references.) (C.H.)

35438 (JPRS-20864) THE USE OF RADIOACTIVE ISOTOPES IN THE STUDY OF SOME PROBLEMS OF FLEA ECOLOGY. PART 2. THE CONTACT OF ANIMALS AND INTENSITY OF THE EXCHANGE OF ECTOPARASITES IN A RHOMBOMYS OPIMUS POPULATION. G. G. Sviridov. Translated from Zool. Zh., 42: 947-9(1963). 4p. (OTS-63-31650)

Fleas labeled with S^{35} were used to study the dispersion of fleas by rodents. Data are presented on the exchange of parasites, the intensity of infestation, and the range of fleas in a population of rodents (Rhombomys opimus) in burrows. The most intensive spread of labeled fleas took place in a radius up to 100 meters from the place where they were released. (C.H.)

35439 ENVIRONMENTAL CONTAMINATION AND GRAZING ANIMALS. R. J. Garner (United Kingdom Atomic Energy Authority, Harwell, Berks, Eng.). Health Phys., 9: 597-605(June 1963).

The premise is put forward that, for purposes of control of environmental contamination from normal atomic energy operations, concentrations of radionuclides in food and water consumed by animals grazing in the vicinity should be limited so that there is no interference with normal farming practice. This entails consideration of hazards both to the animals themselves and to the human consumers of their products. The daily intake of I^{131}, Sr^{90}, and Cs^{137} likely to cause observable injury to sheep and cattle during their economic life span is shown to be considerably greater than that which would render animal products unfit for human consumption, and limiting concentrations of these nuclides in herbage and water thus have to be set in relation to human exposure via meat or milk. For U_{nat}, from which the hazard is due to its chemical rather than radiotoxicity, it is shown that the primary consideration is the health of the animals. (auth)

35440 RADIOACTIVE STRONTIUM IN THE RIVER THAMES. N. T. Mitchell and G. E. Eden (Water Pollution Research Lab., Stevenage, Herts, Eng.). [J. Inst. Water Engrs., 16: 175-87(Mar. 1962)].

The River Thames was monitored for Sr^{89} and Sr^{90} content. The survey demonstrated that at the time the measurements were made there existed a progressive change in the ratio of Sr^{89} to Sr^{90} between Sutton Courtenay, the point of discharge of the Harwell effluent, and Teddington. However, the actual concentrations of Sr^{89} and Sr^{90} found in Thames water in the regions where water is abstracted for public supply were at all times well below the accepted limits for lifetime consumption by a large population, even though the survey was carried out during a period when the rate of flow in the river was exceptionally low. It was concluded that radiostrontium is not retained on the bed of the Thames. (P.C.H.)

35441 FALLOUT AND FOOD SUPPLY. S. A. Laugh. Kasiegaku Zasshi, 54: 747(Nov. 1962).

A picture is given of the behavior of fission product debris resulting from nuclear weapons testing. Possible remedial measures by which the amount of radiostrontium in foods could be markedly reduced are suggested: removing Sr^{90} from milk by passage over ion-exchange resins; treating milk with precipitated tri-calcium phosphate to allow Sr^{90} atoms to displace calcium; searching for chelating agents capable of complexing Sr^{90} and Cs^{137}; and plant breeding—developing crop varieties that reject Sr and Cs, or developing plants that would take up the contaminants avidly. Data on the present situation indicate that the amount of fission products to date has not increased the natural radioactivity of our foods to a serious degree. (Public Health Eng. Abstr., 43: No. 8)

35442 ON THE ACCUMULATION OF RADIATION MATERIALS IN THE BIOSPHERE. F. Koessler (Akademie für Sozialhygiene, Arbeitshygiene, and Arztliche Fortbildung, Berlin). Z. Ges. Hyg. Ihre Grenzgebiete, 7: 571-80 (Aug. 1961).

Problems involved in the increasing radioactivity of the human environment, particularly from radionuclides as fallout from nuclear weapons tests, are considered. The

presence of U and Ra in plants was detected as early as 1909, and in 1929 the accumulation of Ra in plankton was noted. Plankton, as well as algae, bacteria, and protozoans, may adsorb radionuclides by enrichment factors of 10^5 to 10^6 and provide important sources for deposition of isotopes in higher animals. In this way, seafood presents a means whereby Sr^{90} and other long-lived radioisotopes may enter the human body. Even after discontinuation of all weapons tests the radioactivity of the biosphere will continue to rise until the contribution from high-level fallout becomes minimal. However, contamination of water resources will continue as a result of waste disposal from nuclear reactors and will provide an appreciable source of radioactivity in marine plants and animals. In heavily populated Europe, the disposal problem already urgently requires solution. Levels of Na^{24}, Cu^{64}, Fe^{59}, P^{32}, Sr^{90}, Y^{90}, and Cs^{137} in plants and animals are discussed from an ecological viewpoint. (BBB)

Radiation Effects on Living Tissues

35443 (BNL-6500) RADIATION EFFECTS ON CELL RENEWAL SYSTEMS. Harvey M. Patt and Henry Quastler (Argonne National Lab., Ill. and Brookhaven National Lab., Upton, N. Y.). [1962]. Contract [AT(30-2)-Gen-16]. 88p.

An analysis was made of the mechanism of a well-defined syndrome (aplasia) that arises in certain cell systems after a single dose of ionizing radiation. Special attention is given to the systems in which cell production and loss are in dynamic equilibrium, the largest of which are intestinal epithelium and hematopoietic tissues. Other miscellaneous tissues, such as testis, ovary, lens, skin epithelium, hair follicle, cornea, and bone are also discussed. (P.C.H.)

35444 (BNL-6548) THE EFFECT OF TRITIATED THYMIDINE ON THE MORPHOGENESIS OF LATERAL ROOTS. O. L. Stein and H. Quastler (Montana State Univ., Missoula and Brookhaven National Lab., Upton, N. Y.). [1962]. Contract AT(30-2)-Gen-16. 26p.

Primary roots of Zea mays were immersed for 12 to 20 hr in tritiated thymidine solutions (10 μc/cc; 50 μc/root). The roots were grown sufficiently long to permit formation of lateral roots well beyond the region of elongation at time of treatment. No effect on primary root growth during treatment was observed. Ultimate length of the treated roots varied from shorter to equal to the controls. The lateral roots in the region of elongation at time of treatment were inhibited at the early primordium level. Thus a bare region interrupts the normally conical envelope of laterals along the primary root. Lateral primordia which were established prior to or after the treatment appeared not to be severely affected either in number or in length. The distribution of incorporated H^3 was studied in roots harvested during and immediately after treatment, sectioned and autoradiographed. The percentage of nuclei with label was determined separately for the cortex and the stele. In the latter maximum incorporation corresponds well with the beginning of the inhibited region. In spite of the fact that the apical meristem is almost completely labeled it shows much less effect than the primordia of the lateral roots in the sensitive region. Single applications of x rays inhibit lateral root formation throughout the treated region. Judiciously chosen intermittent doses and intervals show some differential inhibition, the older primordia being less affected. (auth)

35445 (BNL-6570) THE EFFECTS OF CHRONIC GAMMA IRRADIATION ON THE GROWTH OF KALANCHOË cv. "BRILLIANT STAR." O. L. Stein and A. H. Sparrow (Montana State Univ., Missoula and Brookhaven National Lab., Upton, N. Y.). [1962]. Contract [AT(30-2)-gen-16]. 51p.

Kalanchoë seedlings were exposed to 330 r/20 hr/day from a Co^{60} source. Samples were harvested weekly. No new leaves were produced after initial exposure to irradiation. Mitosis in the apical meristem appears to have been suppressed. However, the axillary meristems and the cambium continue their activity. This results in a much broadened stem tip with enlarged cells, supported by a stout internode in which cell size has remained relatively normal but cell number has increased. After about 26 days of exposure, meristematic activity in the shoot apex region appears to resume. This results in the formation of growth centers which can give rise to leaves or malformed structures. The original phyllotaxy is not recovered. It is suggested that this resumption of growth may be an instance of adaptation to irradiation. In a second investigation the effect of chronic irradiation at various dose rates and on plants of different ages was tested. The dose rates used were 10, 25, 50, 100, and 250 r/20 hr/day. Plants were in leaf stage 6, 8, 11, and 16 at the beginning of the experiment. No obvious age effect could be determined over this range of leaf stages. At 10 and 25 r/day rate of leaf production does not appear to be affected. At 50 r/day about 5 more leaf pairs are formed before normal activity of the apical meristem ceases. In heavily irradiated plants leaves tended to be larger, broader, and heavier. Much of this is the result of more cells rather than larger cells. Internodes which are formed during irradiation show a reduction in length, largely because fewer cells are formed. The degree of reduction is dose dependent. (auth)

35446 (SAM-TDR-63-26) DEVELOPMENT OF AN APPARATUS FOR PARTIAL CELL IRRADIATION. Ira L. Morgan, Loy D. England, Robert L. Launer, William E. Tucker, Joseph S. Pizzuto, and Charles M. Pomerat (Texas Nuclear Corp., Austin, Tex.). Jan. 25, 1963. Contract AF41(657)-291. 11p.

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An apparatus was developed that allows 16-Mev proton irradiation of selected areas of single living biologic cells cultured in vitro. The highly collimated proton microbeam passes through the tissue culture and is monitored as to number and energy of protons. Extrapolation of individual proton energies allows determination of the energy loss in the tissue. Specific advances, over earlier work in partial cell and microbeam irradiation, include the collimation of 16-Mev protons, cellular alignment technic, and special monitoring methods. (auth)

35447 (TID-3912) EFFECTS OF RADIATION ON THE MAMMALIAN EYE (A LITERATURE SURVEY). Final Report. Hillel Don Lazarus and Blaine H. Levedahl (California. Univ., Los Angeles). Nov. 1962. Contract AT (11-1)-34. 520p.

The literature from 1895 to 1960 was surveyed for references for inclusion in this annotated bibliography on effects of radiation on the mammalian eye. References are included on effects of electricity and light. (C.H.)

35448 (TID-17490) AN EXAMINATION OF STIMULATORY EFFECTS OF IONIZING RADIATIONS IN PLANTS. John Skok and William Chorney (Argonne National Lab., Ill.). Sept. 1962. Contract W-31-109-eng-38. 31p. (UAC-6891)

Studies on stimulatory effects of ionizing radiations in-

cluded seed, plant, and leaf disk x-irradiation experiments. About 1600 plants and over 400 leaf disks were employed, and over 28,000 individual measurements were made. Small but significant growth increases were produced in certain instances, but such results were not always reproducible from one experiment to another. When increases did occur, they were not always produced by the same dose levels. On the basis of these results, the great variability associated with the appearance of positive stimulatory effects and the relatively small increases that are produced, it is doubtful that ionizing radiations, except for genetic and plant-breeding applications, are likely to become useful in increasing agricultural crop yields on a commercial scale. Some of the data obtained in these experiments suggest the possibility that low doses of radiation delivered to dividing cells results in growth depression, but delivered to expanding cells may result in growth stimulation. (auth)

35449 (TID-17870) ABSORBED DOSE IN BIOLOGICAL SPECIMENS IRRADIATED EXTERNALLY WITH COBALT-60 GAMMA RADIATION. Warren K. Sinclair (Argonne National Lab., Ill.). Nov. 1962. Contract [W-31-109-eng-38]. 21p. (UAC-7060)

The average absorbed dose and the maximum and minimum absorbed dose received by biological specimens of varying size, irradiated laterally with a known exposure dose of Co^{60} γ radiation measured in air at the midline was investigated experimentally. Spheres and cylinders covering a range of sizes, filled with ferrous sulfate dosimeter, were exposed to Co^{60} γ radiation to determine the average dose. Maximum and minimum doses were measured using small plastic vials of dosimeter. The data obtained are considered valid for Co^{60} in many exposure situations commonly encountered in radiobiology. (auth)

35450 (TID-17882) THE EFFECT OF TOTAL-BODY X-IRRADIATION ON FATTY ACIDS OF TESTES OF RATS. John G. Coniglio, F. Bartow Culp, James Davis, Wendell Ford, and Frank Windler (Vanderbilt Univ., Nashville. School of Medicine). [196?]. Contract AT(40-1)-1033. 21p.

The effect of total-body x irradiation on testicular fatty acids was studied. Total fatty acid concentration of testes of animals irradiated as adults, weanlings, or prenatally decreased along with the testicular mass. The major change in fatty acid composition in adult and weanling animals was a decrease in arachidonic acid with irradiation. Other changes included a decrease in palmitic acid with irradiation at 29 and 43 days and increases in stearic and oleic acids. Pentaenoic acids increased with irradiation significantly in one group at 22 and 29 days, followed by decreases at 43 and 62 days postirradiation. No changes were seen in gonadal fatty acid composition of offspring of rats irradiated on the 18th day of pregnancy. (auth)

35451 X-RAY SURVIVAL STUDIES ON THE ALGA, BRACHIOMONAS SUBMARINA BOHLIN. H. S. Ducoff, Barbara D. Butler, and Elaine J. Geffon (Illinois. Univ., Urbana). [1962]. Contract AT(11-1)-878. 15p.

Brachiomonas submarina reproduces asexually by undergoing 2 or 3 (occasionally 4) successive divisions, followed by release of the new cells from the mother-cell wall. On a regimen of alternating light and dark periods, divisions and release are confined to the dark period, so that population increase is partially synchronized. On a regimen of continuous illumination, divisions occur at random, and population growth is exponential. Cultures grown under continuous illumination have an x ray survival curve with a relatively high threshold; the LD_{37} is approximately 5 kr. The survival curve of light-cycled cultures irradiated during the light period has the same slope but a lower threshold; the LD_{37} is approximately 3 kr. The culture medium employed and the intensity of illumination did not influence survival. (auth)

35452 (TID-19274) A STUDY OF LETHALITY AND PERMEABILITY CHANGES IN IRRADIATED MICROORGANISMS. Annual Progress Report. Alan K. Bruce (New York. State Univ., Albany. Research Foundation). Aug. 1963. Contract AT(30-1)-2571. 18p.

Studies were made on the factors involved in conferring radioresistance in the bacterium Micrococcus radiodurans. Measurements were made of the intracellular concentrations of p-hydroxymercuribenzoate (HMB) and the effective quantity of internal protective compound present in M. radiodurans. It was found that autoclaving increases the protective action of cystamine, and decreases the effectiveness of MEA in the extract. The effects of HMB on the radiosensitivity of cells were studied by determination of the survival curves of S. lutea and M. radiodurans at lower concentrations of HMB. S. lutea was found to respond more rapidly to the reagent than M. radiodurans. Binding in M. radiodurans as determined by changes in cell survival and by the activation method was found to become constant after two washes. The 8.3×10^{-17} moles/cell of HMB bound in M. radiodurans is equivalent to 5×10^{18} molecules/gram of cells (about 1×10^{11} cells/g). (P.C.H.)

35453 (TID-19287) STUDIES ON MECHANISMS OF MUTATION, RECOMBINATION, AND GENE ACTION IN NEUROSPORA. Progress Report, July 1, 1962–June 30, 1963. (Yale Univ., New Haven). Contract AT(30-1)-3098. 10p.

Combined complementation, recombination, and biochemical studies on neurospora indicate the existence of three (possibly four) discrete groups of mutants that are arranged in co-linear sequences on complementation and genetic maps of the hist-3 region in the chromosome arm in the proximal to distal order: α, β, δ. The three groups apparently correspond to three different structural genes specifying the enzymes (polypeptides) controlling the second, third, and terminal (histidinol dehydrogenage-catalyzed) steps in the biosynthesis of L-histidine. Several other types of mutants also occur. The results indicate that the hist-3 region constitutes an operon (a polarized unit of coordinated transcription). (P.C.H.)

35454 (TID-19291) AN IMMUNOGENETIC STUDY OF THE MECHANISMS OF PROTECTION AGAINST RADIATION DEATH BY TREATMENT WITH HAEMOPOIETIC TISSUES. Research Report, December 1, 1959 to October 31, 1962. Gustavo Hoecker (Chile. Universidad, Santiago). Contract AT(30-1)-2488. 26p.

The relative importance of specific histocompatible loci in the protection afforded by homologous bone marrow to lethally irradiated mice was studied. The complex antigenic differences existing when combinations of B.M. donors and irradiated hosts differ in an unknown number of H-genes into its main components were resolved. Data are given on the contributions to B.M. protection of loci H-1, H-2, and H-3 in different combinations of irradiated hosts and B.M. donors, on the combined effects of H-1 plus H-2, H-2 plus H-3, and H-1 plus H-3, and on the effects of immunizing either B.M. donors or hosts against the well defined H-gene differences. An unexpected finding was that some coisogenic F_1 hybrid donors do not give good protection against hosts. (P.C.H.)

35455 (TID-19302) MODIFICATION OF GENETIC DAMAGE PRODUCED BY IONIZING RADIATION. [Period

Covered]: September 1, 1960–August 31, 1963. Irwin I. Oster (Institute for Cancer Research, Philadelphia). Contract AT(30-1)-2618. 4p.

The results of studies on the genetic effects of radiation on Drosophila melanogaster are briefly summarized. The relative radiosensitivity of several stages of germ cell development to gamma and x rays and neutrons was determined. The results lend support to the view that the extreme radiosensitivity of spermatids is in large measure due to the presence of relatively high amounts of oxygen in such cells. It was found that x irradiation in air or 100% oxygen and neutron irradiation of spermatozoa yields mostly whole-body mutations (80%), while x irradiation in 100% nitrogen or 100% helium yields fewer whole-body mutations (35%). (P.C.H.)

35456 (TID-19327) THE EFFECT OF ALPHA-IRRADIATION ON THE LUMINESCENCES OF ACHROMOBACTER FISCHERI (thesis). Arvin Lovaas (Rochester, N. Y. Univ.). 1956. 58p.

The response of bacterial luminescence to alpha particles is described. The method employed a polonium surfaced paddle to stir a suspension of A. fischeri. The apparent value of the relative biological effectiveness of alpha particles compared to 1000 kvp x rays by this method is about 50. (auth)

35457 (TID-19345) RADIATION STUDIES IN TRANSFORMING DNA, ON TMV-RNA AND ϕX174-DNA. Progress Report, November 1, 1962–October 31, 1963. William Ginoza (Pennsylvania State Univ., University Park). Aug. 1, 1963. Contract AT(30-1)-3116. 26p.

Radiation target sizes of three well characterized single-stranded viral nucleic acids were determined under a variety of conditions in order to examine recent questions raised against the validity of the target theory application. It was found that by avoiding radiation protecting or potentiating agents from the medium in which the target samples are irradiated, molecular weight estimates that are in close agreement with those estimated by conventional physical method can be obtained. In all cases, irradiation was conducted over an atmosphere of air. The target sensitivity of samples tested remains invariant over the experimental temperature range of –180 to +30°C. The radiosensitive molecular weight obtained for R17-RNA, ϕX174-DNA, and TMV-RNA are 0.8×10^6, 1.7×10^6, and 2.2×10^6, respectively, using either a 50-Kv x ray machine or a Co^{60} γ source. The values are identical whether the nucleic acids are irradiated free or still intact in the whole virus. Heat inactivation of transforming DNA at temperatures below the melting transition proceeds by way of depurination. From the ratio of the first order rate constants of inactivation and depurination, the number of base pairs in a genetic marker can be estimated. Using this criterion for marker size, it is found that six randomly selected metabolic markers in the B. subtilis transforming system cannot be differentiated from each other, nor can six antibiotic markers of H. influenzae. It is concluded that marker size has no direct relation to gene size; rather it measures the physical unit required within a donor DNA for recombination with, and repair of, a particular defective segment of the host genome. Heat inactivation of both R17-RNA and TMV-RNA proceeds by a simple first order kinetics. In the Arrhenius plot, the curves for the two RNA's parallel each other with a single slope over the entire temperature range of 55 to 95°C in sodium phosphate buffer, pH 7.15. R17-RNA is inactivated at about one-half the rate of TMV-RNA over this range. Over a one-hundred-fold concentration range, the inactivation rate constants are independent of the concentration at which RNA is heated. It is concluded that phosphodiester bonds of RNA can be severed at neutrality by a mechanism independent of the action of contaminating nucleases. (auth)

35458 (AEC-tr-5947) EFFECT OF RADIUM RADIATIONS ON COLLOIDS, HEMOGLOBIN, THE ENZYMES, AND THE RED BLOOD CORPUSCLES. Victor Henri and Andre Mayer. Translated from Compt. Rend., 138: 521-6(1904).

Radiation was found to have no effect on colloidal silver (negative) but can precipitate colloidal ferric hydrate (positive). A solution of hemoglobin prepared by laking of blood corpuscles became brownish after irradiation for three hours. After 7 hr the brown solution starts to precipitate. Invertin, emulsin, and trypsin subjected to irradiation progressively lose their activity and, after several days of exposure, become completely inactive. Blood corpuscles subjected to radium radiation behave differently toward solutions into which they are immersed than normal blood corpuscles. Their resistance is diminished. They give up hemoglobin and salts to solutions of salt or sugar and leave normal blood corpuscles intact in the hypnotonic solutions. (P.C.H.)

35459 (JPRS-20735) TWENTY-FOUR HOUR PERIODICITY OF MITOSIS IN MICE FOLLOWING THE ACTION OF GAMMA-RAYS. L. P. Kosichenko. Translated from Byul. Eksperim. Biol. i Med., 55: 114-17(Jan. 1963). 6p. (OTS-63-31585)

A study was made of the effect produced by γ radiation (190 and 400 r) on the 24-hr periodicity of mitotic activity of the mouse corneal epithelium. As noted, the 24-hr mitotic rhythm was retained on the 5th postirradiation day (a dose of 190 and 400 r being used). The time of the maximal (8 a.m.) and the minimal (8 p.m.) number of mitosis in the corneal epithelium of experimental mice coincided with control indices. The difference between the maximal and minimal mitotic activity in the two experiments was highly authentic. The range of the 24-hr variations of the number of mitoses showed no significant change in the experimental animals. After irradiation of mice in a dose of 400 r there was a tendency to a rise of the mean 24-hr intensity of cellular multiplication. (auth)

35460 CHANGES IN LEUKOCYTE PHAGOCYTOSIS IN RABBITS AFTER WHOLE-BODY Co^{60} IRRADIATION. A. Puza, J. Simko, E. Kunstadt, and M. Zaduban (Medical Univ., Kosice, Czechoslovakia). Acta Biol. Acad. Sci. Hung., 13: 59-66(1962). (In German)

To investigate possible factors in the failure of homotransplantation, the influence of in vivo irradiation of leukocytes on their subsequent ability to phagocytize bacteria was examined. Rabbits were exposed to a 846-rad, whole-body dose of Co^{60} γ radiation, which was shown in previous experiments to be sublethal for the animals. At intervals, 1 to 50 days following irradiation, the rabbits were examined for changes in body wt, leukocyte count, and phagocytic activity. The latter function was evaluated by observing the in vitro ingestion of Staphylococcus aureus after incubation of bacteria and leukocytes, obtained from venous blood, for ½ hr at 37°C. Body wt began to fall on the 3rd day and fell maximally by the 15th day to 70% of the control level. Circulating leukocyte count fell from an initial value of 9400 per mm^3 to 1800 by the 3rd day; thereafter it rose gradually, to reach near normal values by the 50th day. On the 1st day the percentage of neutrophils rose from 30 to 60% as the percentage of lymphocytes fell from 60 to 35%. For the next 15 days these changes were

reversed as the proportion of lymphocytes began to climb sharply. Phagocytic activity declined precipitously up to the 3rd day, and thereafter more slowly, before beginning to rise again by the 25th day. On the 1st postirradiation day the percentage of granulocytes containing bacteria was 80%, compared with a control value of 100%. The lowest value (60%) was reached between days 8 and 15. By the 50th day it had risen to 90%. It is of interest in regard to transplantation immunity that the marked drop in phagocytic activity on the 3rd day coincides with the beginning of the rejection reaction in the recipient of a homograft. This fact should be observed when animals are preirradiated to prolong homograft survival. (BBB)

35461 EFFECT OF AN ANABOLIC AGENT ON THE TESTICLES OF THE ADULT MALE ALBINO RAT AFTER TOTAL-BODY IRRADIATION. E. Szold, B. Gimes, and B. Erdos (Univ. Medical School, Budapest). Acta Chir. Acad. Sci. Hung., 3: 275-8(1962). (In English)

In rats, an anabolic steroid, 19-norandrostenolone phenylpropionate (depot Durabolin), was found to appreciably influence the course of total-body irradiation given in a single 800-rad dose ($LD_{50/30}$); among rats surviving 30 days the histological appearance of the testes was markedly different from that in the controls. The animals were injected with 5 mg of the steroid 24 hr prior to irradiation. Within 30 days 36% of the injected and 56% of the control animals died, thus showing a 20% difference in survival rate in favor of the steroid-treated animals. Histological examination of the testes was performed on the 7th, 31st, 52nd, and 60th days postirradiation. In the sections stained with hematoxylin-eosin the testes of the 7-day irradiated controls showed a loose structure of the germinal epithelium and irregular nuclear staining. On the 31st day the epithelium in the testes of controls was completely disrupted. The nuclei were barely recognizable on the 52nd day, and signs of fatty degeneration appeared. On the 60th day the steroid-treated animals still showed occasional nuclear staining and spermia in the ducts. Thus, in the testes of steroid-treated animals the degenerative changes caused by ionizing radiation took place later and were less severe than in the controls. No signs of regeneration were detected. (BBB)

35462 THOROTRAST TUMORS: A REVIEW OF THE LITERATURE AND REPORT OF TWO CASES. Sven Dahlgren (Karolinska Institutet, Stockholm). Acta. Pathol. Microbiol. Scand., 53: 147-61(1961). (In English)

Of the two new cases described in detail, the 1st patient was a 41-yr-old man on whom at the age of 21 cerebral angiography had been performed with Thorotrast. After 18 yr he developed recurrent neurofibrosarcomatous tumors in the neck at the site of injection. The 2nd case concerns a man of 64 yr who 21 years previously was injected with Thorotrast in connection with cerebral angiography. At autopsy, Thorotrast deposits were found in liver, spleen, bone marrow, and lymph nodes. In association with large foci of Thorotrast in the hilus of the liver, a moderately differentiated adenocarcinoma had developed from the intrahepatic bile ducts. Metastases were found in the liver and in the regional lymph nodes. In both cases, it is suggested that the Thorotrast tumors were probably elicited by radiation from ThO_2 particles deposited in the tissues. A survey of the literature was made which revealed 59 cases. The latent period between the injection of the contrast medium and the appearance of the malignant tumor is about 18 yr on the average. Reported thorotrastomas are divided into three groups, according to their mode of origin: tumors appearing at the site of injection, tumors due directly to Thorotrast deposited in the organs, or tumors due to Thorotrast injected systemically and deposited in the reticuloendothelial system. The tumors were practically all localized in the liver but a few cases are described where they appeared in other organs in contact with the Thorotrast foci in the liver, spleen, or lymph nodes. In the spleen the changes do not take the form of tumor development but of progressive destruction with fibrosis of the parenchyma. The spleen is usually reduced in size and has a firm consistency. Twenty-six cases of malignant tumors originating in the liver or bile ducts after use of Thorotrast have been reported. An increasing number of cases of liver tumors following application of Thorotrast have been reported in recent years, and more can be expected in the immediate future. (TCO)

35463 EXPERIMENTAL LUNG CANCER INDUCED WITH RADIOACTIVE COMPOUNDS P32, Au198, AND Fe59. T. A. Kochetkova, G. A. Avrunina, and N. D. Sagaidak-Chernyak (Inst. of Industrial Hygiene and Occupational Diseases, Academy of Medical Sciences, USSR). Acta, Unio Intern. Contra Cancrum, 19: 684-6(1963). (In English)

The induction of lung cancer by radioactivity in rats was investigated using Na^{24}, P^{32}, Fe^{59}, and Au^{198}. Local irradiation doses varied from 500 to 15000 rads. Metaplasia of the bronchial epithelium was observed, depending on radiation intensity and half life of the isotope. Cancer was observed after intratracheal administration of Fe^{59}, P^{32}, and Au^{198} after 2.5 to 18 months. (P.C.H.)

35464 NEPHROPATHIES AND RENAL CANCERS AFTER LOCAL IRRADIATION IN RATS. P. Maldague (Institut de Cancer, Louvain, Belg.). Acta, Unio Intern. Contra Cancrum, 19: 697-703(1963). (In French)

Renal parenchyma was found to be much more radiosensitive than previously assumed. One single dose of 800 r or more killed 100% of the animals. First cortical lesions appear in the tubuli contorti and the glomerular capillaries. If one single kidney is irradiated, the other remaining functional, a very pronounced nephrosclerosis appears after a short time in the irradiated kidney. An important number of benign and malignant tumors of renal origin may occur in the atrophic kidney. The latency is long. It is believed that a threshold dose for renal cancerization by x rays exists. (auth)

35465 THE INDUCTION OF TUMORS IN MONKEYS AND RABBITS BY CHEMICAL AND RADIATION AGENTS. R. A. Melnikov (Inst. of Oncology, Leningrad). Acta, Unio Intern. Contra Cancrum, 19: 708-9(1963). (In English)

Brads of radioactive silver (Ag^{110}-0.82-1.109 mC) were introduced into the front wall of the upper jaw of three monkeys and radioactive cobalt (Co^{60}) 0.57 mC to four monkeys. Two monkeys of each group developed malignant tumors within 569 to 1044 days: fusocellular, polymorphocellular, and fibrosarcoma of the upper jaw, squamous-cellular, horny cancer of the mucous membrane of the maxillary sinus. One monkey developed a squamous cellular cornifying cancer of the tongue together with the tumors of the upper jaw. Additional experiments were conducted in 68 rabbits with chemical cancerogens (methylcholanthrene 15-20 mgr and 9,10-dimethyl-1,2-benzanthracene 8-12 mgs). Nonspecific, pretumor, and completely formed tumoral lesions were observed. The development of malignant tumors was traced during the experiment by rontgenological method. Thus, the experimental production of tumors of the upper jaw was realized and studied. (P.C.H.)

35466 EFFECTS OF NUCLEAR WEAPONS ON THE VISION OF SURVIVORS: A REVIEW OF THE LITERA-

TURE. Edwin B. Mehr. Am. J. Optometry, 39: 683-7 (Dec. 1962).

Although serious ocular damage to the survivors of the Hiroshima and Nagasaki explosions was minimal, conditions of these bombings do not necessarily relate to ocular damage to humans and animals reported from subsequent tests. Because of the focusing effect of the eyes' optical system, it is subject to damage at far greater distances from the explosion than any other human organ. Secondary effects were noted in the retina of 400 survivors exposed at Nagasaki and Hiroshima, but these ocular lesions were apparently related to deficiency in blood elements caused by the general somatic effects of radiation and these lesions disappeared without residual damage. Examinations were made of six human cases of chorioretinal burns from accidental viewing of test atomic explosions. One observer, miles from ground zero in Nevada, purposely looked at the fireball with one eye, out of curiosity; a photograph of it is permanently inscribed on his retina. Within 6 weeks his acuity had been reduced from 20/20 to 20/100. Recovery time may vary from a few seconds to several days. The experience of Hiroshima and Nagasaki indicates that many more survivors will suffer extended periods of flash blindness than will suffer retinal burns in any use of nuclear weapons. Visual hazard varies with the size of the explosion, height of the explosiqn, condition of the atmosphere, dark adaption of the eye, and direction of the gaze. High altitude detonations present possibilities of severe effects since the radiation traverses less of the atmosphere than is the case in an air-burst and consequently less energy is lost by atmospheric attenuation. Rabbits exposed to radiation from a megaton-range weapon, detonated at night at an altitude of 252,000 feet, showed chorioretinal burns at a distance of 345 mi. In this type of high altitude detonation, the energy is released so quickly that protection from the blink reflex or iros constriction, or a shift of gaze is impossible. In the case of large weapons, exploded in the air, the energy is released more slowly in 2 distinct pulses. The first lasts about $^1/_{10}$ of a sec for a 1-megaton explosion. The first pulse can cause temporary or permanent effects to those viewing the explosion. The second pulse carrying 99% of the thermal radiation, lasts about 10 sec for a 1-megaton explosion. The protective mechanisms of the eye, such as the blink reflex and pupil, could operate to reduce exposure during the second pulse, but many persons attracted by the explosion might turn their gaze to look at it and thus cause retinal burns. (BBB)

35467 LOCAL IRRADIATION OF THE THYMUS. HISTOLOGIC CHANGES WITH OBSERVATIONS ON CIRCULATING LYMPHOCYTES AND SERUM PROTEIN FRACTIONS IN ADULT MICE. Nemetallah A. Ghossein, Henry A. Azar, and Julia Williams (Columbia Univ., New York and Francis Delafield Hospital, New York). Am. J. Pathol., 43: 369-79(Sept. 1963).

Shortly following local irradiation of the thymic region in adult C_3H mice with 3000 r tissue dose, in one exposure, there occurred a marked decrease in the number of circulating lymphocytes associated with an almost complete disappearance of the lymphocytic population of the thymus. Subsequent repopulation of the thymus was accompanied by a return of the lymphocyte count to pre-irradiation levels. Plasma cells and other pyroninophilic lymphoic cells appeared in large numbers in the thymus and mediastinal lymph nodes 2 weeks following local irradiation of the thymic region. This finding was associated with a significant rise of serum gamma globulin concentration. It is suggested that these results indicate an immune response to antigenic byproducts of irradiation. (auth)

35468 EFFECT OF RADIATION ENVIRONMENT ON THE THERMAL RESISTANCE OF IRRADIATED SPORES OF BACILLUS SUBTILIS. J. J. Licciardello and J. T. R. Nickerson (Massachusetts Inst. of Tech., Cambridge). Appl. Microbiol., 11: 216-19(May 1963).

An attempt was made to determine the effect of environmental conditions during irradiation on the degree of induced heat sensitization B. subtilis on spores. The degree of heat sensitization induced in the spores by γ irradiation was not changed when irradiation was carried out at low oxygen tension (1 mm Hg) as compared with irradiation in air. Heat sensitization was slightly greater at pH 7.0 than at pH 4.5. Culture media were found to influence the degree of induced heat sensitivity, with less effect being produced by complex organic substrates. Thus, radioinduced thermal sensitization was slightly greater when the spores were suspended in phosphate buffer (pH 7.0) as compared with nutrient broth or ham puree: the same effect was observed with spores of Clostridium sporogenes. Apparently, the complex molecules in the organic substrates compete with the free radicals formed during irradiation of the aqueous solvent and thus protect the spores from indirect effects during irradiation. B. subtilis was sensitized to heat less by irradiation at 90°C than was C. sporogenes P.A. 3679. A dose of ~800,000 rep prior to heating was required to reduce the D value (decimal reduction time) of C. sporogenes P.A. 3679 by 90%, whereas with B. subtilis 1,200,000 rep was needed to cause a 90% decrease in the D value. A possible explanation for this is that the catalase of B. subtilis might destroy any hydrogen peroxide formed within the spore during irradiation and thus prevent damage from this toxic compound. Spores of C. sporogenes P.A. 3679 being catalase-negative might be injured to a greater degree during irradiation than spores of B. subtilis. (BBB)

35469 RADIATION CHEMISTRY OF PROTEINS. 1. MODIFIED LYSOZYME SUBSTANCES. Clarence O. Stevens, Bert M. Tolbert, and Floyd E. Reese (Univ. of Colorado, Boulder). Arch. Biochem. Biophys., 102: 423-9 (Sept. 1963).

Crystalline egg-white lysozyme was irradiated with 0.66 Mev γ-rays, and the resulting sample subjected to amino acid analyses, fractionation by phosphate precipitation, and column chromatography on Bio-Rex 70. No significant changes are observed in amino acid levels in samples given a 30 Mrads dose in the presence of air. In samples receiving 29.8 Mrads in vacuo, no significant changes occur in amino acid composition of fractions obtained by phosphate precipitation. In samples receiving 124.8 Mrads in vacuo, the phosphate-soluble fraction contains appreciably larger numbers of lysine, arginine, and valine residues per 131 peptide linkages than the unirradiated lysozyme. Chromatographic elution patterns of phosphate-soluble fractions of irradiated lysozyme samples reveal several enzymically active proteins. Four of the chromatographic peaks retain enzymic activity. At levels of 14.5 and 71.5 Mrads the main peak is higher in enzymic specific activity than the original material and is eluted earlier from the column. Deuterium-exchange rate studies show that peptide hydrogens in the protein are more susceptible to exchange with deuterium after irradiation. Hard-to-exchange amide (peptide) hydrogens are lost at least twice as rapidly as enzymic activity as a function of radiation dose up to 45 Mrads. (auth)

35470 THE ACTION OF IONIZING RADIATION ON THE COENZYME A CONTENT OF ANIMAL ORGANS AND THE EFFECT OF CYSTEAMINE AND RESERPINE ON IT. O. Strubelt (Universitlt, Erlangen, Ger.). Arch. Exptl. Pathol. Pharmakol., 245: 95(1963). (In German)

Whole-body irradiation of mice with 700 r led to anorexia and wt loss, and in the late radiation reaction to a significant decrease in the concentration of coenzyme A in liver, kidney, intestine, brain, and spleen. This enzymic deficiency was not the result of the anorexic state of the animals caused by radiation sickness nor of insufficient absorption of pantothenic acid from the digestive tract. Thus, control mice which were not irradiated but pair-fed with the same amount of food consumed by the anorexic irradiated mice did not show a loss in tissue coenzyme A. Also, intraperitoneal injection of pantothenic acid in the irradiated mice did not prevent the fall in coenzyme A levels in various organs. When the mice were treated with cysteamine or reserpine, which acted as radioprotective agents in raising the survival rate of irradiated animals, the fall in coenzyme A level was inhibited in liver and brain but not in the kidney. (BBB)

35471 PROTECTIVE ACTION OF ETHYL PALMITATE AGAINST ROENTGEN RADIATION. K. Flemming and Chr. Flemming (Heiligenberg Institut, Ger.). Arch. Exptl. Pathol. Pharmakol., 245: 129(1963). (In German)

Earlier studies showed that splenectomized animals recover faster from radiation injury than controls with intact spleens, and that intravenous injection of ethyl palmitate results in destruction of the spleen. It might be expected that chemical splenectomy, which is less stressful to the animal than the surgical operation, might confer significant radioprotection. In preliminary toxicity studies with mice, it was found that the degree of purity of ethyl palmitate, injected intravenously as an emulsion, is of great importance. Injection of 100 mg of the technical grade resulted in death of 20% of the animals within 12 hr, whereas 80% died after injection of a similar amount of the purified fat. Female mice were more sensitive to the fat than males. Animals surviving for 24 hr after injection appeared normal and were used for radiation experiments. A considerable radioprotective effect was obtained by intravenous injection of ethyl palmitate 48 hr before 690-r irradiation; 53% more injected mice survived than uninjected controls. The degree of purity of the preparation used did not influence its radioprotectivity. Further experiments showed that the protective action increased with injected dose over the range 25 to 100 mg. Surgical splenectomy 48 hr before irradiation was found to be almost as effective as injections of the fat. The mechanism of the protective effect of the fat was not clear since maximum effectiveness was reached 48 hr after the injections. Further studies will be required to determine whether its effect is a nonspecific one rather than one manifested through the reticuloendothelial system or the adrenal cortex. (BBB)

35472 LOCAL PROTECTION BY MACROMOLECULES AGAINST EPILATION BY X IRRADIATION. Z. M. Bacq (Université, Liège). Arch. Intern. Pharmacodyn., 139: 85-91(Sept. 1962). (In French)

Various substances were injected under the skin of 8-day-old C57 mice which were then exposed to 550-r, whole-body doses of x rays. This dose usually caused complete epilation 7 to 9 days later, except around the eyes and mouth and on the feet. Injection of 0.05 to 0.1 ml of 10^{-3} or 10^{-4} M $Na_2S_2O_3$ solution subcutaneously 3 min prior to irradiation protected the skin against epilation at the site of injection. Synovial fluid, a concentrated solution of mucopolysaccharides and protein, also gave marked and consistent protection when injected 3 min before irradiation but was ineffective when injected after irradiation. Thiogel A (an artificial gelatin rich in sulfhydryl groups, molecular wt 10,000) also induced local protection in skin but, when injected intraperitoneally, did not alter the mortality curve. Thiogel A conferred a lower degree of local protection than $Na_2S_2O_3$ or synovial fluid. Thiogel B (which contains the same proportion of sulfhydryl groups as Thiogel A but has a molecular wt of 100,000) and heparin also prevented radioinduced epilation when injected subcutaneously before irradiation. These macromolecules, all of which contain sulfhydryl or sulfate groups, appeared to stimulate regeneration of hair follicles as well as protect them against the injurious effect of radiation. (BBB)

35473 INFLUENCE OF THE ADMINISTRATION OF RADIOACTIVE PHOSPHORUS (P^{32}) ON THE GENITAL APPARATUS OF PUBERTAL AND PREPUBERTAL RATS. Mainaldo Maneschi, Pietro Ragonese, and Ettore Cittadini (Università, Palermo, Italy). Arch. Ostet. Ginecol., 66: 9-37(Jan.-Feb. 1961). (In Italian)

Prepubertal (30-day-old) and pubertal (150-g) female rats were injected subcutaneously with 3 to 6 μC/g doses of P^{32}-orthophosphate and sacrificed up to 60 days later. The young rats were given two injections spaced 8 days apart and the older rats a single injection of isotope. A third group of adult female rats were given 3.5 or 7 μC/g and examined 6, 12, and 30 days later. Body wt loss was observed in all three groups of rats receiving the isotope. Fertility and histologic changes in ovary and uterus were studied. Ovaries were smaller in rats receiving P^{32} and the granulosa cells of developing follicles showed cytoplasmic vacuolation and pyknosis. In some follicles mitoses were more numerous than in controls. These changes were present after the low dose; after the higher dose, atretic follicles were present and corpora lutea completely lacking. Minimal changes were noted in the uteri of treated prepubertal rats, including a flattening of epithelium of endometrium and an increased muscle/connective tissue ratio of myometrium. Pubertal rats treated with the higher dose showed progressive anorexia, asthenia, ruffling of the fur, and hemorrhagic crusts about the eyes and nose, followed by death. These rats also revealed follicular atresia, which was more severe with the higher dose. Of the adult female rats treated with P^{32}, only 1 out of 30 became pregnant after mating, and 8 of the 13 fetuses showed arrested development and resorption. This is in contrast to a pregnancy rate of 50% in rats not treated with P^{32} and a mean fetal count of nine per animal. Ovaries and uteri from this group showed histopathologic changes resembling those seen in the other two groups. The results demonstrate the high sensitivity of the graffian follicle to irradiation by P^{32}. (BBB)

35474 ON THE THROMBOELASTOGRAPHIC CHANGES FROM THE EFFECT OF RADIOTHERAPY OF UTERINE AND TUBAL NEOPLASIA. P. Bergamaschi and E. Schiatti (Università, Pavia, Italy). Arch. Ostet. Ginecol., 67: 101-12(Mar.-Apr. 1962). (In Italian)

A thromboelastographic investigation was made of changes in blood coagulability caused by irradiation of 15 patients aged 46–76 yr for treatment of either uterine cervical carcinoma, adenocarcinoma of the body of the uterus, or carcinoma of the fallopian tubes. Fractional x-ray doses of 200 r were given, with total doses up to 12000 r, and elastograms were made for each patient after receiving doses of 2000, 6000, and 12000 r. In general, the results showed an increasing hypocoagulability of blood as

irradiation dosage mounted. Progressive significant changes were noted in the parameters of the elastograms: time of reaction (r), time of formation of coagulum (k), and max amplitude (ma). The value of r increased according to a regression coefficient of 0.136 ± 0.010 (standard deviation) per 1000 r; k also increased, according to a coefficient of 0.123 ± 0.028 per 1000 r. The value of ma fell during treatment, by a coefficient of −0.918 ± 0.17. An inverse proportionality was seen between ma and the values of r and k. This is represented by the thromboelastographic index (TI), obtained by dividing ma by the sum of r and k. TI declined during therapy, according to a regression coefficient of −0.211 ± 0.022. The data do not permit tracing the cause of this radiation-induced hypocoagulability to deficiency of any particular clotting factor. (BBB)

35475 EFFECTS OF X RAYS ON GUINEA PIG CELLS CULTURED IN VITRO. II. INFLUENCE OF ENVIRONMENTAL FACTORS ON SURVIVAL. G. Marin (Università, Padua). Arch. Sci. Biol. (Bologna), 46: 73-82(1962). (In Italian)

Various factors influencing radiosensitivity of cells of the RCP strain of guinea pigs were investigated. The number of colonies arising from cells exposed to 0-, 100-, 200-, 300-, 400-, and 500-r doses of x rays, delivered at a rate of 150 r/min, did not differ significantly, although at the three highest doses ~10% fewer colonies formed, compared to unirradiated cultures. The number of colonies formed from cells irradiated with 300 r declined progressively as the number of cells in the irradiated culture increased from 10^3 cells/ml to 10^6 cells/ml. Fewer cells survived irradiation at 37°C than at 3, 13, 21, or 29°, but there was no difference in the survival rate of cells irradiated at the four latter temperatures. Cells irradiated in the presence of air showed ~50% reduction in survival compared to unirradiated cells; however, in the presence of nitrogen, survival of irradiated and unirradiated cells was similarly depressed. Fewer cells survived when irradiated in the stationary growth phase than in the logarithmic phase, indicating relatively greater radiosensitivity of metabolically inactive cells. (BBB)

35476 BIOSYNTHESIS OF GLUCOSAMINE FROM VARIOUS HEXOSE-6-PHOSPHATES BY HOMOGENATES OF COLON OF RATS TREATED OR NOT TREATED WITH X RAYS. I. Cescon and A. Cavina Pratesi (Università, Milan). Arch. Sci. Biol. (Bologna), 46: 187-94(1962). (In Italian)

Adult male Sprague-Dawley rats were exposed to 500- or 1000-r, whole-body doses of x rays; and at various subsequent periods, from 1.5 to 216 hr postirradiation, the colon was removed and homogenized. After the 500-r dose the colon showed no macroscopic changes, but 70 hr after 1000 r the colon was hyperemic and showed frequent teleangectasia and capillary hemorrhage, accompanied by mucosal fragility. The colonic homogenates were incubated at 37°C with the 6-phosphate derivatives of glucose, fructose, mannose, and galactose, and the amount of glucosamine-6-phosphate synthesized was estimated by chromatographic and colorimetric assay. After the 500-r dose the synthesis of glucosamine from glucose-6-phosphate rose progressively up to the 96th hr postirradiation to a max rate twice that of control colon, then declined slightly at 216 hr. After 1000 r a similar, slightly greater rise in the synthesis rate was noted. The radiation-stimulated formation of glucosamine was not quite as marked when fructose-6-phosphate was used as the precursor; no such stimulation was noted with mannose-6-phosphate; and galactose-6-phosphate did not act as a precursor for glucosamine-6-phosphate. With both control and irradiated colon, max glucosamine formation was obtained after 60-min incubation of homogenates in pH 7.7 phosphate buffer containing 10 μM precursor, 10 μM glutamine, and 1 μM ethylenediaminetetraacetate. The results indicate that the enzyme system responsible for glucosamine synthesis is markedly activated 3 to 4 days after in vivo irradiation of intestine even though cellular injury is present at this time. (BBB)

35477 THE PERITONEAL GRAFT IN CUTANEOUS RADIONECROSIS; EXPERIMENTAL STUDIES. A. Pannella and F. A. Paolini (Università, Pavia, Italy). Arch. Sci. Med., 112: 149-62(Sept. 1961).

Development of nonhealing ulcers in the skin of patients undergoing radiotherapy is discussed, and methods of applying grafts to these lesions are considered. Experiments were conducted in rabbits to explore the possibility of using homologous or heterologous grafts of peritoneum for this purpose. Lesions in the dorsal skin of rabbits were induced by local application of single 20,000-r doses of 60-kv x rays. After 2 weeks the lesions were radically excised to remove necrotic tissue and treated with solutions of penicillin and streptomycin. Immediately, peritoneal tissue obtained from other rabbits or from guinea pigs was sutured over the skin lesion. The animals were injected daily with broad-spectrum antibiotics, whereas in the controls the open lesions were topically treated with powdered sulfonamides or physiologic solution containing penicillin and streptomycin. All of the ulcers (2- to 3-cm dia) treated by peritoneal grafts showed complete healing after 40 days. Six days after grafting the wound showed a clear plaque with fibrin deposition and intense development of granulation tissue. Typical epidermis and dermis developed under the graft, including normal hair follicles. Similar results were obtained with homologous and heterologous grafts. It is concluded that the peritoneal graft protected the ulcer from infection and presented a receptive matrix for proliferation of host cells which rapidly covered the wound. (BBB)

35478 ON THE MECHANISM OF THE RADIOPROTECTIVE EFFECT OF NICOTINIC ACID AMIDE ON EHRLICH ASCITES TUMOR. R. Koch and S. Klemm (Universität, Freiburg i. B.). Arzneimittel-Forsch., 12: 465-7(1962). (In German)

Previous studies provided evidence of the protective effects of nicotinamide (NA) against radiation in the Ehrlich ascites tumor. Its effect was further studied to determine whether the protective effect is connected with the function of NA in diphosphopyridine nucleotide (DPN) and thus with anaerobic glycolysis. Irradiation of Ehrlich ascites cells with x rays results in inhibition of anaerobic glycolysis and in reduction of the resting DPN content. Both these processes are protected by addition of NA. The protection of DPN requires higher doses of NA than does that of glycolysis. Whereas glycolysis is completely inhibited following irradiation with 70 kr, 26% of the original content of stationary DPN may still be recovered following the same radiation dose. The mechanisms underlying the protection of glycolysis and resting DPN content may not, however, explain the protection of tumor growth, because this is much more sensitive to radiation than glycolysis or DPN content. Experiments with 6-aminonicotinamide revealed no new aspects relevant to the protection of tumor growth by NA, since this antagonist of NA did not influence radiosensitivity. (BBB)

35479 THE INFLUENCE OF VARIOUS RADIOPROTECTIVE SUBSTANCES ON THE RADIOSENSITIVITY OF

EHRLICH CARCINOMA IN VITRO AND IN VIVO. R. Koch, I. Onderka, and I. Seiter (Universität, Freiburg i. B.). Arzneimittel-Forsch., 12: 265-70(Mar. 1962). (In German)

Experiments in mice involving irradiation of the ascites tumor in vitro showed significant protective effects of cysteamine, nicotinic acid amide and serotonin, whereas thiourea, D-penicillamine, 5-mercaptopyridoxine, and nicotinic acid were found to increase the sensitivity of the tumor to radiation. In vivo experiments with the solid tumor showed marked increases of the resistance of the tumor towards local radiation doses after intraperitoneal injection of cysteamine and serotonin in mice. 5-Mercaptopyridoxine and D-penicillamine also appeared to increase resistance, whereas thiourea showed no effect. The lack of protection with thiourea in vivo is unexpected since it was effective in vitro and is known to act as an acceptor of OH radicals released in the primary radiation reaction. The differences in the effect of some agents on the tumor cells in vitro and in vivo may reflect a direct toxicity of these agents on the cells when tested in vitro. (BBB)

35480 EFFECT OF ETHIONINE, 6-MERCAPTOPURINE, AND IRRADIATION WITH X RAYS AND GAMMA RAYS ON THE INCREASED METABOLISM OF MEPROBAMATE INDUCED BY PRETREATMENT WITH LUMINAL. R. Kato and E. Chiesara (Università, Milan). Atti Accad. Med. Lombarda, 15: 392-6(1960). (In Italian)

When rats were pretreated with phenobarbital (Luminal), liver slices showed an increased ability to catabolize meprobamate 12-48 hr later. The effects of ethionine, 6-mercaptopurine and x and γ radiation on this increase of meprobamate metabolism were studied. Single whole-body 750-r x-ray and 700- or 2100-r Co^{60} γ-ray doses were given 6 to 12 hr after injection of phenobarbital. When 250 mg/kg ethionine was injected 30 min before phenobarbital administration, the induction of increased metabolism was completely inhibited. If ethionine was administered after phenobarbital, the inhibitory effect was markedly decreased. Such decrease was dependent on the time interval between the pretreatment and ethionine administration. In contrast, 6-mercaptopurine and x or γ radiation did not inhibit the induction of increased metabolism of meprobamate. It is suggested that the increased drug metabolism after phenobarbital treatment depends on the biosynthesis of nucleic acids which then control elaboration of the liver apoenzyme. Although 6-mercaptopurine and ionizing radiation are known to inhibit nucleic acid synthesis, they apparently do not affect the precursors of the meprobamate-metabolizing enzyme system. (H.H.D.)

35481 STUDIES ON THE USE OF MUTAGENIC AGENTS IN PLANT BREEDING. I. THE EFFECT OF SEED MOISTURE CONTENT ON SENSITIVITY TO X RAYS IN LUPINUS ANGUSTIFOLIUS. C. M. Francis and J. S. Gladstones (Univ. of Western Australia, Nedlands). Australian J. Agr. Res., 14: 12-19(Jan. 1963).

Seeds of Lupinus angustifolius were exposed to doses of 2.5, 5, 10, and 20 kr at moisture contents ranging from 6.1 to 18.1% (fresh wt). X_1 plant damage was measured in terms of reduction in height at 110 days from sowing, delay in flowering, and reduction in mean seed yield per plant. The three measures were found to be highly correlated. Survival was not significantly affected within the range of treatments used. Radiosensitivity increased progressively with decreasing moisture contents below 11.6%, seeds with 6.1-7.6% being four to five times as sensitive as those with 11.6-16% moisture content. The latter range represented a plateau of min sensitivity. Between 16.0 and 18.1% moisture, sensitivity again increased. Flowering time was the most sensitive measure of plant damage in that it was the only one to register consistently an effect due to the lowest x-ray dose (2.5 kr). This indicates that flowering time could be the most reliable, for comparative purposes, of the indices used. In addition it has the important advantage of being quickly and accurately scored. The magnitude of the protection against x-ray damage afforded by increased seed moisture can be expressed quantitatively in terms of a dose reduction factor (DRF), i.e., the factor by which the dose tolerated by the most sensitive seeds is less than that required to cause the same level of damage in the most tolerant seeds. DRF (in the present experiments between four and five for all three indices of x-ray damage) represents the damage caused to the seeds by 5 kr at 6-7% moisture as being ~ the same as that caused by 20 kr at 11-16% seed moisture. This is similar to the factor of about four previously found for barley seedling height and survival, but differs from the value of 10 found for seedling leaf span and survival in tomato. It is possible, however, that the extremely low moisture contents obtained in tomato seeds (as low as 1.2%) contributed to the difference, and that greater DRF might have been found for barley and lupins had lower min seed moisture contents been obtained. It is proposed that in subsequent generations, a corresponding DRF be derived for mutation rates. This should show whether or not the protective effect of moisture against plant damage in the X_1 is paralleled by a similar protection against mutation. If it is not, as appears to be the case in barley, it should be possible to define a particular range of seed moisture contents at which the highest mutation rates can be obtained. (BBB)

35482 HYDRATED ELECTRONS AND RADIOBIOLOGICAL SENSITIZATION. G. E. Adams and D. L. Dewey (Mount Vernon Hospital, Northwood, Middx., Eng.). Biochem. Biophys. Res. Commun., 12: 473-7(Aug. 20, 1963).

The contributory factor of capture and stabilization of the electronic charge by the additive molecule to radiosensitization is discussed. Studies were made on the radiosensitization effect of N-ethylmaleimide, p-benzoquinone, benzophenone, and diacetyl on Serratia marcescens. Benzoquinone was found to be toxic at low concentrations, N-ethylmaleimide was not toxic, and benzophenone and diacetyl had a very significant effect on the sensitivity of bacteria to x rays. (P.C.H.)

35483 EFFECT OF X-RAYS ON BACTERIAL RIBOSOMES. Pankaj Ganguly (Saha Inst. of Nuclear Physics, Calcutta). Biochim. Biophys. Acta, 75: 59-64(July 23, 1963). (In English)

Crude extracts from starved, non-irradiated, and irradiated Escherichia coli cells were collected in 3 mM phosphate buffer containing 0.01M Mg^{2+}. The radiated cells were found to contain diminished amounts of free RNA- and 88-S ribosomes. Starved cells also showed similar effects. At the various doses used, up to 90 krads, it was observed that 70-S particles were not affected, whereas the amount of 88-S particles was greatly diminished. It was concluded that the enzyme system that controls the conversion of 70-S to 88-S particles was more susceptible to radiation damage. (auth)

35484 LIFE CYCLE ANALYSIS OF MAMMALIAN CELLS. I. A METHOD FOR LOCALIZING METABOLIC EVENTS WITHIN THE LIFE CYCLE, AND ITS APPLICATION TO THE ACTION OF COLCEMIDE AND SUBLETHAL DOSES OF X-IRRADIATION. Theodore T. Puck and Jan Steffen (Univ. of Colorado, Denver). Biophys. J., 3: 379-97(Sept. 1963).

Equations are presented describing the accumulation of cells at any part of the life cycle as a result of addition of specific blocking agents. An experimental methodology using these relationships is described which makes possible analysis with relatively high resolution of the distribution of cells throughout the life cycle in normal cultures or those treated with various agents. The action of colcemide on S3 HeLa cells studied by this method revealed that colcemide has no effect on the G1, S, or G2 stages; it blocks cells quantitatively at the metaphase-anaphase region; but it accumulates mitotic figures only from the cells which have not yet entered mitosis at the time of its addition. The technique was also applied to study the efficiency of x-irradiation in delaying the entrance of G2 cells into mitosis. A definite lag was found at the lowest dose studied which was 9 rads. Only the cells confined to a central region of G2 at the time of irradiation are affected by this dose. (auth)

35485 ANTITHROMBOPLASTIN AND ANTITHROMBIN ACTIVITY AFTER IRRADIATION. G. Caprino, G. Cittadini, and L. Maccioni (Università, Siena, Italy). Boll. Soc. Ital. Biol. Sper., 38: 1321-4(Dec. 31, 1962). (In Italian)

Hypocoagulability in whole-body irradiated rabbits appeared to result primarily from prolongation of an early phase of the clotting process, especially thromboplastin formation. To ascertain whether this was the result of a direct effect of radiation on factors involved in thromboplastin formation or release of an anticoagulant into the circulation, studies were conducted on rabbits exposed to whole-body doses of 200 or 800 r of 220-kv x rays. Antithromboplastin activity, estimated by the method of Tocantins, 1 to 18 days postirradiation, showed no significant changes from the normal in either of the irradiated groups. By this method the prolongation of recalcification time in a mixture of plasma and thromboplastin is measured. Likewise, no change in antithrombin activity was apparent when it was measured by the method of Koller and Fritschy. This finding indicates that there is no increase in the level of heparin or heparinoids in the blood of irradiated rabbits. (BBB)

35486 RADIOPROTECTIVE ACTION OF ORGANIC THIOLS. I. RADIOPROTECTION WITH MESO-DTS (MESO-DITHIOSUCCINIC ACID). F. Cugurra and E. Balestra (Università, Genoa). Boll. Soc. Ital. Biol. Sper., 39: 8-9(Jan. 15, 1963). (In Italian)

The effect of meso-dithiosuccinic acid in irradiated guinea pigs was tested since it resembles other radioprotective agents in its chemical structure and therapeutic activity in heavy metal poisoning. When injected intraperitoneally for 7 days in daily doses of 10 mg/kg, it did not prolong the life of guinea pigs exposed to 800-r, whole-body doses of x rays. At doses of 20 or 100 mg/kg/day it did not protect animals exposed to 600 r. At 10 mg/kg/day it had only a slight protective effect (20%) after 400 r. After midlethal doses (300 r) a 10-mg/kg/day intraperitoneal drug dose increased survival to 80-100% from 40-50% in untreated irradiated controls. Doubling the drug dose did not increase its effectiveness. It is concluded that this compound has radioprotective activity at midlethal x-ray doses, and that the amount of it required to exert this effect is far below its toxic or lethal doses. (BBB)

35487 RADIOPROTECTIVE ACTION OF ORGANIC THIOLS. II. RADIOPROTECTION WITH DL-DTS (DL-DITHIOSUCCINIC ACID). F. Cugurra and E. Balestra (Università, Genoa). Boll. Soc. Ital. Biol. Sper., 39: 10-11 (Jan. 15, 1963). (In Italian)

The possible radioprotectant activity of dl-dithiosuccinic acid was tested in guinea pigs exposed to 300 to 600 r (skin dose) of whole-body x irradiation. It was injected intraperitoneally in single doses of 20 and 100 mg/kg or in 7 daily doses of 10 mg/kg/day. After 11 days 100% of irradiated control guinea pigs were dead, whereas 30% of the animals injected with 20 mg/kg doses were living and 100% mortality was not reached until the 15th day. With the 100 mg/kg dose, slightly less protection was noted, 20% of the animals surviving beyond 11 days. After 300 r (LD_{50}), slight protection was also noted, 60% surviving after 7 daily 10-mg/kg doses. Protective effects were not obtained with the single 20 and 100 mg/kg doses. Results indicate that the meso form of this compound is most effective in therapeutic doses, in contrast to the presently tested DL form which is most active in prophylactic doses. (BBB)

35488 EFFECTS OF WHOLE BODY IRRADIATION AND OF PARTIAL HEPATECTOMY ON THE LIVER LESIONS INDUCED IN RATS BY A SINGLE DOSE OF RETRORSINE, A PYRROLIZIDINE (SENECIO) ALKALOID. R. Schoental and J. P. M. Bensted (Medical Research Council, Carshalton, Surrey, Eng. and Royal Cancer Hospital, Sutton, Surrey, Eng.). Brit. J. Cancer, 17: 242-51 (June 1963).

Rats which survived 100 days after a single oral dose of retrorsine (30 mg/kg) were exposed to whole body irradiation (400 r); 25 of the rats survived more than a year after the alkaloid, and developed a variety of tumors at various sites. Primary liver tumors, one of which was a hepatocarcinoma with metastases in the lung, were present in six rats. Among 29 rats which survived more than a year after a single oral dose of retrorsine (30 mg/kg) and received no further treatment, five developed hepatomata. Two hepatomata were present among nine rats which were given a single oral dose of retrorsine (30 mg/kg) following partial hepatectomy. Tumors at various sites (but not of the liver) were present in six rats which survived more than one year after whole body irradiation (400 r). Whole body irradiation or partial hepatectomy did not inhibit the development of chronic liver lesions and liver tumors caused by a single oral dose of retrorsine. On the basis of the present experiments there is no definite evidence of a synergistic action due to these agents. (auth)

35489 ACUTE ACCIDENTAL SUPERFICIAL X-RAY BURNS: AN INTERIM REPORT OF 11 CASES. R. D. Sweet (South Devon and East Cornwall Hospital, Plymouth, Eng.). Brit. J. Dermatol., 74: 392-402(Nov. 1962).

For a 6-day period a soft x-ray unit was incorrectly operated with the result that 11 patients who should have received treatment with grenz rays generated at 10 kv received instead x rays generated at 50 kv through a 0.05-mm aluminium filter for a time appropriate for the delivery on the skin surface of 100 r at 10 kv. The patients were being treated for chronic eczema, generally on the hands. The surface dose delivered was estimated at 6450 r, this falling to 1050 r at a depth of 5 mm and to 450 r at 10 mm. The reaction was similar in all cases. Erythema was the most variable of all effects, both in time of onset and in severity. Nine patients had a marked erythema by the 5th day. The erythema was symptomless for the first 2 or 3 days, but rapidly increased in intensity and in about half the cases became progressively darker in color. It was in no way modified by local applications. Prednisolone in doses of 40-5 mg/day was given orally and as local treatment a proprietary ointment containing 3% terramycin and 1% hydrocortisone was used throughout until epithelialization was well advanced. No antibiotics were given systemi-

cally, and in no case did secondary infection occur. The first signs of healing were detected in each case by the 21st day. In general, epidermal destruction was complete, but dermal loss did not occur and dermal changes were confined to the superficial layers. The complete lack of production of granulation tissue by burnt dermis resulted in progressive slowing in the rate of healing the farther new epidermis had to grow from the edge of a burnt area. The marked leucocytosis seemed dependent on dermal inflammation rather than on epidermal destruction. Treatment with large doses of prednisolone appeared to lessen pain and help maintain function. (TCO)

35490 RECOVERY EFFECT PRODUCED BY ISOLOGOUS NATIVE DEOXYRIBONUCLEIC ACID IN UV IRRADIATED L-STRAIN CELLS. O. Djordjević, Lj. Kostić, and D. Kanazir. Bull. Boris Kidrich Inst. Nucl. Sci., 14: 59-65(Apr. 1963). (In English)

L-strain cells were irradiated by uv rays and treated with isologous native DNA. The data show that the cells are capable of dividing faster than irradiated nontreated ones. The effect seems to be dependent upon the amount of DNA added to the irradiated cells. (P.C.H.)

35491 BIOLOGICAL ACTION OF HIGH-ENERGY PROTONS (500 Mev). Yu. I. Moskalev and I. K. Petrovich. Byul. Eksperim. Biol. i Med., No. 5, 73-7(May 1963).

Data on the effects of high-energy protons on the duration of life and the condition of the peripheral blood were obtained in experiments on 490 white rats (Wistar line). Doses of 28, 39, 114, 275, 358, 422, 760, 864, and 1008 rad were given at a rate of 0.7-2.3 rad/sec and a pulse frequency of 100/sec. The LD_{50} for animals after 30, 60, and 120 days was 600 ± 35 rad, and after 15 days, 710 ± 45 rad. High-energy protons differed little from x and gamma rays with respect to their effect on duration of life. Dynamic observation of the condition of the peripheral blood showed that more significant changes occurred in the white blood cells composition in the initial period after irradiation (up to 28 days). The most essential changes appeared in the red blood cells after 6-7 months. The form of the dose-effect curve depended essentially not only on the physiological peculiarities of the system being investigated, but also on the period of observation. An increased effect following an increased dose should not always be expected. (TCO)

35492 LEUKEMIA AFTER RADIOIODINE THERAPY FOR HYPERTHYROIDISM. Kenneth R. McCormack and Glenn E. Sheline (Univ. of California, San Francisco). Calif. Med., 98: 207-9(Apr. 1963).

Follow-up studies showed that, among 650 patients with hyperthyroidism treated with radioiodine between 1945 and 1961, two cases of leukemia occurred. In one patient the diagnosis of chronic lymphatic leukemia was made 3 yr after I^{131} therapy. Acute or subacute myelomonocytic leukemia developed in the other patient after an interval of 14 yr. The 1st patient received three doses of I^{131} totaling 24.6 mc, and the 2nd received a single 2-mc dose. These treatments were estimated to give whole-body doses of 20 and 2 rad, respectively. However, no conclusions were drawn regarding a possible causal relation between this therapy and the subsequent occurrence of leukemia. Assuming that equal numbers of new patients are treated with I^{131} each year, the total number of patient-years and, therefore, the expected incidence of coincidental leukemia, will increase with the square of time since the introduction of radioiodine therapy. Therefore, whether or not a causal relation exists, an increasing number of reports of leukemia occurring in I^{131}-treated thyrotoxic patients can be expected. (BBB)

35493 X-RAYS, LEUKEMIA, AND EXECUTIVE HEALTH EXAMINATIONS. Can. Med. Assoc. J., 88: 209-10(Jan. 1963).

Periodic executive health examinations sometimes include several abdominal x-ray investigations designed to detect neoplasms before they give rise to symptoms. However, it is suggested that the widespread use of x rays in this manner may conceivably result in a higher death rate from leukemia than from the disease that is being sought. This conclusion is based on studies of Stewart et al. showing increased leukemia incidence from diagnostic radiology exposure in Great Britain. Since the use of diagnostic x rays is much more widespread in North America than in Britain, it might be expected that on this continent the proportion of leukemias induced by x rays may be higher than the 8% estimated on the basis of these studies in Britain. The World Health Organization estimates that the average exposure to x rays in the United States is about seven times as great as that in Britain. It is therefore recommended that considerable discretion be exercised in ordering x-ray investigations, particularly those involving exposure to the trunk, least the risk involved outweighs the benefits derived. A consideration of the use of barium meals on a routine basis to detect early carcinoma of the stomach reveals a high estimated risk of this procedure as compared to its potential benefits. It is estimated that the risk of developing leukemia as a result of a barium series is ~16 cases per 100,000, almost double the change of detecting an asymptomatic, curable carcinoma of the stomach. (BBB)

35494 EFFECT OF RADIATION ON EEG IN MAN. E. Klimkova-Deutschova (Charles Univ., Prague). Cesk. Neurol., 26: 184-91(May 1963).

EEG and clinical data are given on 42 men and 4 women who had been exposed to various types of radiation for 1 to 17 years–41 to centimeter-length waves, 4 to meter-long ones, 1 to x ray. The main clinical symptoms were somnolence, apathy, chronic fatigue, and neurotic signs. Of 54 tracings, 30% were abnormal mainly with decreased vigilance and sleep waves. Both EEG and clinical signs showed preponderance of inhibition over activation. (OTS)

35495 EFFECT OF X RAYS ON RHIZOGENETIC PHENOMENA IN JERUSALEM ARTICHOKE TISSUE CULTIVATED IN VITRO. Shankar Narayanaswamy. Compt. Rend., 257: 508-10(July 8, 1963). (In French)

The neoformation of roots is progressively inhibited by increasing doses of x rays. The susceptibility of tissues to irradiation is revealed to be at a maximum approximately 8 days after being placed in culture solution. The minimum dose required for the complete inhibition of rhizogenesis is 400 r, but a partial inhibition is obtained for a much lower dose of the order of 50 r. (tr-auth)

35496 ON THE RESULTS AND FAILURES IN THE TREATMENT OF RADIOINJURY OF THE URETERS AND BLADDER IN FEMALE GENITAL CARCINOMA. W. Krebs and M. Mebel (Hufeland Krankenhauses, Berlin). Deut. Gesundheitsw., 16: 1542-5(Aug. 17, 1961). (In German)

Thirty cases of radioinjury to ureters and bladder are described, 10 of which were treated conservatively and 20 surgically. As a result of radiotherapy of cervical carcinoma, six developed severe radioinduced cystitis, four cystitis plus ureteral stenosis and urinary stasis, 13 bilateral ureteral stenosis and urinary stasis, four unilateral stenosis and stasis, and three vesicovaginal fistula. Of the

10 patients treated conservatively with bladder instillations and prednisone, five showed improvement, four did not, and 1 died. Of eight treated surgically by nephrostomy, only one was improved and 7 died. Most of the other patients, who were treated by nephrectomy and plastic surgery showed improvement. Most of the nephrostomy patients who died were already in renal failure before intervention. Plastic surgical repair of the injured ureters is described in several cases, and improved urinary function following prednisone therapy was also demonstrated by pyelography. (BBB)

35497 HISTOPATHOLOGIC CHANGES IN LENS EPITHELIUM AFTER ROENTGEN IRRADIATION. Luigi Scullica (Università, Rome). Doc. Ophthalmol., 16: 231-9(1962). (In Italian)

The right eye of adult male rats of the Osborne-Mendel strain were irradiated with a single 1000-r dose of x rays; both eyes were removed 1 hr to 28 days later and examined histologically. At 1 hr postirradiation the postequatorial zone of the lens showed no changes, but in the preequatorial and equatorial zones the number of mitoses was 10% less than that in the left lens. Atypical anaphase and telophase figures and unequal distribution of chromosomes were seen in the right lens epithelium. At 2 hr, degenerative and lytic changes were seen in nuclei in the postequatorial zone, and in the other zones, mitoses were further diminished in number. By the 4th hr, nuclear fragmentation was evident, and the 1st changes were present in the central zone of lens epithelium. Degenerative changes in nuclei continued to dominate the histologic picture for the 1st week postirradiation, following which there were acellular areas in the epithelium. After the 2nd week, numerous atypical mitoses were seen, giving rise to giant nuclei. These nuclei were 2–3 times normal size, were only slightly granulated, and stained weakly by the Feulgen method. By the 4th week the pre-equatorial and equatorial zones showed large, confluent acellular regions, with giant nuclei scattered throughout the cellular regions. The central zone of the epithelium appeared to be the most radioresistant and the equatorial zone the most radiosensitive. (BBB)

35498 THE EFFECTIVENESS OF THE PROTECTION OF THE RABBIT SPERMATOZOIDS AGAINST GENETIC INJURIES ARISING FROM THEIR IN VITRO IRRADIATION. N. I. Nuzhdin and G. V. Nizhnik. Dokl. Akad. Nauk SSSR, 151: 446-8(July 11, 1963). (In Russian)

It was found previously (Zhur. Obshch. Biol., 21: 430 (1963) No. 6) that ovary transplants increase the protective effect of cysteamine. The same approach was extended to the study of effect of protective agents under elimination of the interference of the organism, by determining their action in the case of the in vitro irradiation of spermatozoids of chinchilla rabbits. The spermatozoids were exposed to a total dose of 800 r, using a Co^{60} source, while placed in a solution of β-mercapto ethylamine or β-amino ethyl isothiouronium bromide hydrobromide and also while treating the ejaculate with N. The female animals were artificially inseminated and killed after 18 to 20 days of pregnancy. Irradiation of the spermatozoids in the physiological solution only resulted in 84.5% death among the embryos, as compared with the control group. Of the 3 agents, only N exhibited a protective action, lowering the incidence of dominant lethal injuries. This was due to the reduction of the dissolved O in the ejaculate by N. The absence of the protective action in the other cases was probably due to their inability to enter in reaction with the DNA present in the spermatozoid. (TTT)

35499 CHANGES IN THE NUCLEOTIDES OF THE SPINAL GANGLIA OF IRRADIATED ANIMALS. V. M. Lavrinenko (Pavlov Medical Inst., Ryazan, USSR). Dokl. Akad. Nauk SSSR, 151: 694-6(July 21, 1963). (In Russian)

In order to improve the knowledge of the nucleoproteids of the protoplasma in various parts of the nervous system, the changes in ribo- and desoxyribo nucleoproteids (RNP and DNP) after exposure of white rats to a single, whole-body irradiation of 600 r were measured, using the conventional techniques. The animals were killed 1, 3, 5, 7, 12, 14, 30, and 40 days after the exposure, the ganglia were treated with an alcohol–formalin–vinegar mixture and were sealed in paraffin. Analysis of the RNP and DNP content in the sensitive neurons of the ganglia indicated changes in a few days after irradiation. During the acute radiation sickness, 12 to 14 days after the exposure, a general lowering of the RNP content was noted; the material was often absent in the region near the cell nucleus. After 30 and 40 days, the main neurons were found to be greatly depleted in RNP. However, during the radiation sickness period, some of the neurons contained the same amount of RNP as the specimens from the control animals. About 6 to 8 months after the irradiation the RNP reaction of the sensitive neurons approached the standard value. No explanation was found for clarifying the changes of the DNP content in the nuclei of the pseudounipolar nerve tissues of the spinal ganglia after the irradiation. (TTT)

35500 THE EFFECT OF CERTAIN PROTECTIVE MATERIALS ON THE CHANGES IN THE REACTIVITY OF SULFHYDRYL GROUPS IN THE TISSUE OF IRRADIATED ANIMALS. L. I. Korchak and T. A. Speranskaya (Severtsov Inst. of Animal Morphology, Academy of Sciences, USSR). Dokl. Akad. Nauk SSSR, 151: 712-13(July 21, 1963). (In Russian)

It was found earlier (Doklady Akad. Nauk SSSR, 102: 939(1955) No. 5; Ibid., 135: 1254(1960) No. 5) that after whole-body irradiation the concentration of the sulfhydryl group does not change but their activity in the radiosensitive tissues is affected, resulting in a reduction of the SH concentration in the surviving tissue homogenate. This problem was further investigated by studying the effects of protective agents, including morphine, unithiol, β-amino ethyl isothiouronium bromide hydrobromide (AET), cysteamine, and cystamine. The tests involved the determination of the changes in the reactivity of the sulfhydryl groups in the spleens of mice. White mice of both sexes were subjected to a dose of 700 r of x radiation, after they were injected with one of the above materials; the amount used was determined on the basis of the survival index. The activity of the sulfhydryl groups was determined after incubation of the homogenate at 37°C. The results showed that the sulfhydryl group content in the spleen homogenate of both irradiated and unirradiated animals decreases but this decrease is more pronounced in the first case. Introduction of morphine, AET, cysteamine, and cystamine exerted a protective action but addition of unithiol did not weaken the radiation effect. (TTT)

35501 CAN A DOSE OF 4-5000 r OF X RAYS DOUBLE THE LONGEVITY OF D. MELANOGASTER? B. P. Sonnenblick and J. Grodis (Rutgers Univ., Newark, N. J.). Drosophila Information Serv., 37: 130(Jan. 1963).

Attempts were made to confirm the report of Strehler that x-ray doses of 4000-5000 r double the longevity of Drosophila melanogaster. Several tests were conducted on a Canton-S strain maintained in mass culture on standard media. Radiological factors were the same in all tests (90 kvp, 5 ma, no added filter, 960 r/min as

measured in air), but other factors differed. In one study, 1-day-old flies of both sexes were exposed, while in the other 7-day-old flies were irradiated. They were kept for 3 or 4 days, respectively, in mass culture, etherized, and then two pairs of males and females were placed in separate vials. Unirradiated flies were similarly treated and observations were made regularly. After the 2nd week, vials were changed every 7 days. When 1-day-old flies were exposed to 4000 r of x rays, it was found that the mean life span of combined females and males was 47.6 days and that of the controls was 46.2 days. When 7-day-old flies were treated, the mean longevity of irradiated (4000 r) adults of both sexes was 46.4 days while that of controls was 44.2 days. It is concluded that an x-ray dose of 4000 r does not double the mean life span of treated as against untreated flies, and that a dose as large as 4000 r does not seem to influence life span significantly. (BBB)

35502 ELECTROCORTICAL ACTIVITY IN THE RAT X IRRADIATED DURING EARLY DEVELOPMENT. M. Berry, B. G. Clendinnen, and J. T. Eayrs (Univ. of Birmingham, Eng.). Electroencephalog. Clin. Neurophysiol., 15: 91-104(Feb. 1963).

Pregnant female rats were irradiated with 200 r on the 17th, 19th, or 21st day of gestation. Other newborn rats received 200-r head irradiation on the 23rd, 26th, or 29th day after conception. In both groups the effects of irradiation on cortical structure and on the electrical activity of the brain were studied. Structural changes resulting from this treatment ranged from major disorganization in rats irradiated on the 17th day following conception to absence of any apparent abnormality in animals irradiated on the 29th day. The development of the corpus callosum was impaired in all prenatally irradiated groups. These abnormalities were associated with changes in electrocortical activity which, although related to the severity of the structural disorganization, were of lesser significance. The electroencephalogram and electrocorticogram of prenatally irradiated rats were of smaller amplitude than normal and exhibited an abnormal amount of fast spiky activity. Recruiting response of treated animals maintained a shape which was characteristic of the normal response. The potentials evoked in the earliest irradiated group were of small amplitude, while in all the prenatally irradiated groups the duration of the negative wave was reduced. In all other treated animals, however, both spatial and temporal components of the response were normal. These findings support the view that thalamocortical integration is necessary for the manifestation of certain aspects of the spontaneous activity of the brain. They emphasize the extent to which spontaneous and evoked activity depend upon events occurring within the thalamus. The high frequency spiky activity seen in prenatally irradiated animals indicates that an essential link in the thalamocortical reverberatory circuit has failed to develop. It is proposed that the cells in the superficial layers of the cortex may project fibers, either directly or indirectly, to the thalamus and that they act homeostatically in their capacity to maintain slow cortical rhythms. In the absence of the superficial layers of the cortex, the thalamus of the prenatally irradiated rat is deprived of cortical influence and exhibits the phenomenon of runaway. The thalamus under these conditions elicits impulses at a higher frequency than is normally the case. Consequently the burst activity in the cortex is greater in frequency and more sustained than in the cortex of normal animals. (BBB)

35503 THE EFFECTIVE MECHANISM OF CHEMICAL RADIATION PROTECTORS. S. Fallab and H. Erlenmeyer (Universität, Basel). Experientia, 19: 374-6(1963). (In German)

Possible mechanisms for the action of substances inhibiting radiation damage, especially 1-hydrazinophthalazine, are discussed. From experiments designed for simulation of irradiated aqueous systems, it can be concluded that this inhibiting action is caused by the special redox kinetic behavior of the compound toward strong oxidizing agents. (auth)

35504 EFFECTS OF X-IRRADIATION DURING HIBERNATION ON TISSUE CATECHOLAMINE CONTENTS. X. J. Musacchia, M. Jellinek, and Th. Cooper (St. Louis Univ.). Experientia, 19: 418-19(1963). (In English)

Hibernating squirrels were subjected to a single, whole-body exposure of 2000 r of x rays. Catecholamine values in active non-irradiated and active irradiated ground squirrels were similar. The kidney and liver of hibernating ground squirrels had significantly greater ($P = 0.05$) concentrations of catecholamine than the kidney and liver of active animals. Catecholamine levels in tissues of irradiated hibernating ground squirrels were comparable to those of the irradiated active animals, however, they were lower than those of non-irradiated hibernators. In particular, kidney and liver catecholamine concentrations were significantly decreased ($P = 0.05$). Squirrels irradiated during hibernation and then aroused had tissue catecholamine levels comparable to those of irradiated active and irradiated hibernating animals, but were lower than non-irradiated hibernators. (P.C.H.)

35505 RADIOMIMETIC EFFECTS OF A NITROGEN MUSTARD ON SURVIVAL, GROWTH, PROTEIN AND NUCLEIC ACID SYNTHESIS OF MAMMALIAN CELLS IN VITRO. A. G. Levis, L. Spanio, and A. De Nadai (Università, Padua). Exptl. Cell Res., 31: 19-30(June 1963).

The effects of different doses of a nitrogen mustard (HN2) on a guinea-pig cell strain grown in vitro, were compared to the effects of x-rays on similar systems. The survival curve is similar to those obtained after x-irradiation. The low extrapolation number suggests that, also in this case, the loss of reproductive capacity may be due to the induction of lethal mutations, probably chromosomal. The growth curves give evidence of the inhibition of cell multiplication. The inhibition is immediate and increases with increasing doses. Some of the inhibited cells, however, may eventually recover the capacity to multiply. When the inhibition is permanent, the cells grow into giants. Despite mitotic inhibition, the synthesis of proteins and RNA continues until highly abnormal cellular levels are reached. DNA synthesis is the most sensitive to HN2 treatment, and is stopped early, when the DNA content per cell doubles its normal value. The early inhibition of synthetic processes would appear to be secondary to the block of cell division, although a direct effect on DNA synthesis cannot be excluded. (P.C.H.)

35506 REDUCTION OF NUCLEAR DAMAGE IN X-IRRADIATED RAT THYMOCYTES BY ELEVATED SALT CONCENTRATIONS. J. F. Whitfield and R. H. Rixon (Atomic Energy of Canada Ltd., Chalk River, Ont.). Exptl. Cell Res., 31: 140-8(June 1963).

A fixation procedure not employing a heavy metal-containing fixative, was used to show that radioinduced nuclear damage probably represents a disaggregation of more uniform dispersal of chromatin instead of condensation and that exposure of cells after x irradiation to media

with increased contents of NaCl reduces or prevents the development of the nuclear damage. The development of the typical pycnotic morphology, which has been interpreted as chromatin condensation, was observed when irradiated cells were fixed for histological examination in the presence of a heavy metal. In the absence of heavy metal from the fixation procedure, however, the development of radiation damage in thymocyte nuclei was seen as a loss of the fine chromatin reticulum and replacement by structureless, homogeneous nuclei. Evidence was found to support the idea that radiation damage in thymocyte nuclei involves chromatin disaggregation. (P.C.H.)

35507 INTERACTIONS OF X RAYS AND LIGHT IN THE PRODUCTION OF THE ELECTRORETINOGRAM. C. S. Bachofer and S. Esperance Wittry (Univ. of Notre Dame, Ind.). Exptl. Eye Res., 2: 141-7(Apr. 1963).

Under proper conditions, x rays can induce an electroretinogram (ERG) in the vertebrate retina, similar in some respects to the ERG induced by light. X rays in sufficiently high doses damage the retina and impair the production of the ERG, so the doses used were below the level at which immediate damage could be detected. Provision was made for delivering to the eye either flashes or continuous exposures of light or of x rays, or of the two simultaneously to compare the ability of the retina to respond to these two types of stimulus. The ability of the retina to recover completely from short flashes of x rays at different frequencies of stimulation was confirmed. This adaptation differed from that observed in another experiment in which x rays and light were delivered concomitantly and partial adaptation was observed. Flashes of x rays delivered to the retina during exposure to light and flashes of light delivered to the retina during exposure to x rays revealed a pattern of inhibition followed by adaptation. Thus, in these two situations, exposure to light or exposure to x rays, the modes of adaptation are not completely parallel. In the first case, the exposure to light immediately blocks the ability of the retina to produce an ERG in response to x-ray flashes, but over a period of 1-2 min the retina partially regains its ability to produce an ERG. No matter how long the illumination lasts, the adaptation is only partial; a max ERG response to x-ray flashes can never be elicited during light exposure. In the case of exposure to x rays, the adaptation required to produce an ERG in response to light flashes follows a different pattern. Immediately after the beginning of the x-ray exposure, it is possible to elicit an ERG in response to a light flash, but this ERG is always considerably reduced in amplitude. Over a period of ~1 min the amplitude increases slightly, and then begins a gradual decline. As the period of x-ray exposure continues, damage to the retina begins to manifest itself and interferes with the experiment. It is concluded that the interaction between x rays and photoreceptors differs in some fundamental way from the interaction between light and photoreceptors. (BBB)

35508 INCREASED LIVER WEIGHT IN BONE MARROW CHIMERAS. C. C. Congdon and A. L. Kretchmar (Oak Ridge National Lab., Tenn.). Exptl. Mol. Pathol., 2: 277-90(June 1963).

Lethally irradiated mice treated with bone marrow develop enlarged livers within two weeks. When donor bone marrow is isologous, the liver returned to a normal wt in about 20 days. However, when donor marrow is homologous, the liver wt was maximal at about two weeks, and the liver remained heavier than in the sham-irradiated, normal controls throughout the 95-day period of observation. The total nitrogen content of the liver of homologous marrow-treated mice was considerably increased during the period of maximal liver enlargement, but normal nitrogen concentration was maintained. Glycogen and lipid content of the liver was normal, but phosphorus concentration in the foreign marrow-treated mice was elevated. Histologic study of the enlarged liver demonstrated individual hypertrophy of liver cord cells. Some extramedullary blood formation was present. During the period of liver enlargement, maximal proliferation of blood-forming cells and antibody-forming tissue in the spleen was observed. Correlation of liver wt with spleen wt was observed at the early intervals in the foreign marrow-injected animals, but was not present at 55 to 95 days. There was always a correlation between liver and spleen wt in isologous marrow-treated mice. This was also true in normal controls. Increased liver wt in the bone marrow chimera may represent a work hypertrophy to provide essential metabolites, such as the purine precursors, for the proliferating cellular systems of the hematopoietic and lymphatic organs. The graft-against-host antibody-forming tissue's cytotoxic action not only destroys the lymphatic organs but also has the effect of a general protoplasmic poison and injures many tissues, including the liver. In destroying the lymphatic tissues, the graft antibody-forming tissue is itself destroyed. This concept provides for a general cytotoxic action to graft-against-host antibody-forming cells, and the final metabolic disturbance and death in secondary disease result from such systemic poisoning. (BBB)

35509 APPLICATIONS OF A BIOPHOTOMETRIC METHOD TO THE STUDY OF BACTERIAL RADIOPROTECTION. R. Masironi (Università, Rome). Farmaco, (Pavia), Ed. Sci., 16: 751-4(Nov. 1961).

A new technique is described which enables quantitative evaluation of the radioprotectant action of various substances on bacterial cultures. Present methods which depend on the ability of surviving irradiated bacteria to form colonies are dependent upon many uncontrollable variables that prevent quantitative results. The new method, which is simple and rapid, depends upon the turbidimetric measurement of the number of bacterial cells forming at carefully controlled temperatures in shaken cultures subjected to ionizing radiation in the presence of protective agents. When transmittance values are plotted against time, the protective action of an agent is immediately evident. The method was evaluated with Staphylococcus aureus cultured in tritiated water with a specific activity of 41.6 mc/ml, with and without added cystamine (0.33×10^{-5} moles/ml). In the absence of cystamine, no decrease in transmittance (or bacterial multiplication) occurred, whereas cystamine alone had no effect on the transmittance curve. The 50% transmittance point was reached after 6 hr incubation in cultures in distilled water with or without cystamine and after 12 hr in tritiated water containing cystamine. Preliminary experiments with this method also showed the protective action of glutathione and sodium thiosulfate. (BBB)

35510 THE EFFECT OF GAMMA IRRADIATION ON THE SURVIVAL OF BACTERIUM COLI IN AN EXTERNAL ENVIRONMENT. A. P. Volkova. Gigiena i Sanit., No. 3, 101-3(1963).

A radioresistant strain of E. coli was obtained from strain M-17 by up to 10 gamma irradiations. Suspensions of 2×10^9 microbes of the original and the radioresistant strain per ml physiological solution were cultured on various media under sterile and nonsterile conditions, keeping them at room temperature in light or in the dark. The media were: sand, earth, water, physiological solu-

tion, moleskin, wood, leaves, paper money, oilcloth, and paper. Survival varied from 11 days on paper, oilcloth, and wood to 8 months on earth and sand. While in the sterile tests no significant difference was observed between irradiated and non-irradiated bacteria, the survival was under nonsterile conditions 1–1.5 months longer in 8 of 20 alternatives for the irradiated specimens than for the non-irradiated, and only in 2 cases shorter. This is attributed to the reduction of antagonistic properties of the irradiated strain and the natural flora. A difference in biological behavior between the irradiated and the non-irradiated strain was observed only in later periods. E. coli citrovorum was detected in sterile and nonsterile cultures of the radioresistant M-17 strain on water and earth after 4–5 months, but was never observed in the control cultures. Hence, the appearance of citrate-positive strains of E. coli may be indicative of radioactive contamination. (OTS)

35511 A GEOMETRICAL ANALYSIS OF THE SEATED HUMAN BODY FOR USE IN RADIATION DOSAGE CALCULATIONS. David L. Dye (Boeing Co., Seattle). Health Phys., 9: 749-56(July 1963).

The tissue thicknesses in all directions about twelve selected points in a seated human body were determined. These isothickness contours are useful in computation of absorbed dose at these points due to external omnidirectional radiations, such as space protons or hard γ rays. Fractional solid angles for each thickness are given for use in isotropic flux dose computations. (auth)

35512 EFFECT OF X RAYS ON THE METABOLISM OF GLUCOSE AND FATTY ACIDS IN THE MALE MOUSE. F. Geissbuehler and P. Favarger (Université, Geneva). Helv. Physiol. Pharmacol. Acta, 20: C56-7(1962). (In French)

Attempts were made to evaluate the relative importance of the degradation of glucose by the glycolytic route and by oxidation of pentoses in irradiated mice. Male mice were given whole-body, 600-r doses of x rays and 24 hr later injected intravenously with 25 μc glucose-1,2-C^{14}. Twelve min afterwards the animals were sacrificed, palmitic acid separated chromatographically, and its 1st two carbon atoms split off from the fatty acid chain. The results indicated that irradiation did not influence the rate of incorporation of glucose fragments into fatty acid but altered the route of their incorporation. The proportion of radioactivity in palmitic acid resulting from the oxidative pathway rose from 4.3 to 8.6%. Thus fatty acid synthesis is relatively radioresistant, which is in accord with previous findings. The relative increase in oxidative metabolism suggests that the organism tends to maintain a constant level of reduced coenzymes I and II. The wt of the mice, their fatty acid content, and the composition of their fatty acids were not affected by irradiation. (TCO)

35513 A HISTOPATHOLOGIC STUDY OF RADIATION-INDUCED CARCINOMA OF THE SKIN. M. V. Sirsat (Tata Memorial Hospital, Bombay). Indian J. Pathol. Bacteriol., 5: 156-63(July 1962).

Histopathological observations in six cases of radioinduced carcinoma of the skin and one of precancerous radiation keratosis are presented. The material was obtained from radiologists, physicians, and a technician who were occupationally exposed to x rays. All of the lesions were located on the dorsal or palmar aspects of the fingers. It is not known whether the primary change in skin cancers induced by radiation occurs in the epidermis or whether the change starts in the dermis resulting in a subsequent epidermal carcinoma. Radiation-induced changes in the epidermis observed here can be traced from precancerous keratosis and intraepithelial carcinoma to a fully formed squamous or basal cell carcinoma. In one case the skin of the tissue adjacent to the carcinoma showed a small area of intraepithelial carcinoma. This suggests a multicentric origin. X irradiation as an etiological factor in epidermal carcinogenesis is reaffirmed as the lesions studied here occurred on fingers, an uncommon site for spontaneously occurring carcinoma. The basal and epidermoid carcinomas following radiation were identical to those arising spontaneously. (TCO)

35514 EFFECTS OF RADIATIONS ON PURIFIED 3-HYDROXYANTHRANILIC ACID OXIDASE. A. Vescia (Università, Ferrara, Italy). Ital. J. Biochem., 12: 47-55 (Jan.-Feb. 1963). (In English)

The effects of uv and x irradiation were studied on a highly purified preparation of 3-hydroxyanthranilic oxidase. It was noted that the inactivation arising from irradiation becomes larger as the pH of the enzymatic solution is lowered. Ferrous ions exercise a strong protective action on the inactivation determined by irradiation, which cysteine fully annuls. The results are discussed in relation to the structure of the enzyme active center and to the interaction between ferrous ions and protein. (P.C.H.)

35515 ON THE BIOLOGICAL ACTION OF RADIOACTIVE SULFUR. N. M. Oganesyan (Inst. of Physiology, Academy of Sciences, Armenian SSR). Izv. Akad. Nauk Arm. SSR, Biol. Nauki, 16: No. 6, 61-8(1963).

Investigations on the toxicity and effects of S^{35} on the organism established that the minimum lethal dose of the isotope for mice is 15, and for rats–20 microcuries per kilogram body weight; the LD_{100} for mice is 40 and for rats–45 microcuries per kilogram body weight. S^{35} was uniformly distributed throughout the organism; the isotope upon its entry into the organism induced degenerative modifications of leukocytes and produced temporary anemia, neutrophilia, and eosinophilia. The greatest changes were noted in the spleen: these were manifested by atrophic processes in the lymph follicules. (OTS)

35516 RADIATION-RESISTANT, PIGMENTED COCCUS ISOLATED FROM HADDOCK TISSUE. Norman S. Davis, Gerald J. Silverman, and Edmund B. Masurovsky (Massachusetts Inst. of Tech., Cambridge). J. Bacteriol., 86: 294-8(Aug. 1963).

An orange-brown, catalase-positive coccus was isolated from irradiated haddock. The new coccus was found to consist of rough and smooth strains as well as strains possessing appreciably less pigment. The smooth strain (248) was more radioresistant to gamma radiation than the rough strain, and at higher radiation doses was of comparable resistance to Micrococcus radiodurans. The less-pigmented strain was as radioresistant as its parent strain (248). Although morphologically similar to other, but less-resistant, micrococci, the coccus differed by growing slowly on solid media, and was unable to grow in 7% salt. It was distinguished from M. radiodurans by being smaller in size and in being capable of reducing nitrate to nitrite and hydrolyzing gelatin. (auth)

35517 CARCINOMA OF THE THYROID GLAND IN YOUTH: A SECOND LOOK TEN YEARS LATER. A Raventos, Robert C. Horn, Jr., and I. S. Ravdin (Univ. of Pennsylvania, Philadelphia). J. Clin. Endocrinol. Metab., 22: 886-91(Sept. 1962).

Resurvey of a previously published group of 22 young (< 25 yr) thyroid cancer patients after an interval of 10 yr revealed two to be dead, one of thyroid cancer and one

of another malignancy, two living with pulmonary metastases, and 18 alive without evidence of disease. During the 10-yr interval it was learned that 11 of the patients had received thymic irradiation in infancy. The data so far accumulated still do not prove that irradiation causes thyroid cancer in man or that children are more susceptible than adults. It has been consistently established, however, that the majority of children with thyroid cancer diagnosed now have a history of prior therapeutic irradiation, if sufficient effort is made to elicit it. The probability of detecting an association between childhood irradiation and thyroid cancer will diminish with the age at which the thyroid cancer is diagnosed. Both the availability of parents for questioning and their ability to recall events from the patient's early childhood decreases with the age of the patient. Also, physicians may be more likely to search for radiation histories in young thyroid cancer patients than in old, since the association has been reported primarily in children to date. If an association between irradiation and thyroid cancer is more likely to be found when it occurs in the young, then an exaggerated impression of greater susceptibility of the youthful thyroid to carcinogenic influences of radiation might be created. This might be further augmented by a skew in the age-distribution of therapeutic radiation exposure. Most of the reported cases received their irradiation for some benign disease of childhood, predominantly so-called thymic enlargement or lymphoid hyperplasia. There is little to support the notion that thyroid cancer is more likely to follow irradiation of children than of adults. Case reports of childhood thyroid cancer are almost nonexistent before 1930 and rise very sharply after 1940. This increasing incidence of thyroid cancer cannot be estimated well from death certificates because of the relatively long survival of young thyroid cancer patients. It is concluded that the question of a causal relation of thyroid cancer with previous irradiation cannot be profitably investigated by study of the reported incidence rates for the disease or for radiation exposure, since both data are highly incomplete and subject to serious biases. (BBB)

35518 MOTOR PERFORMANCE IN THE RAT AS A FUNCTION OF AGE AND PRENATAL X IRRADIATION. Stanley Wechkin, Riley F. Elder, Jr., and Ernest Furchtgott (Univ. of Tennessee, Nashville). J. Comp. Physiol. Psychol., 54: 698-9(Dec. 1961).

It was previously demonstrated that locomotion on narrow parallel bars is impaired in pre- and neonatally x-irradiated rats when the animals were tested at the age of 27 days. Further studies were designed to ascertain whether the observed deficit is permanent, or whether it might be even enhanced with aging since it has been hypothesized that ionizing radiations may induce aging. An investigation was made of the generality and permanence of this radioinduced motor impairment and the relation of age to motor functions in the rat. Ability to climb an inclined plane was studied as a function of age and prenatal x irradiation, 200 r on the 16th to 17th day of gestation. The rats were tested at the age of 4 to 5, 15, or 20 to 21 months. The irradiated rats were significantly inferior to the controls, and age was inversely related to the ability to climb an inclined plane. However, the older irradiated group probably contained healthier animals since prenatally irradiated rats were found to die or develop tumors at a much earlier age than normal controls and their disability or death frequently occur between 15 and 21 months. Thus, the data are not conclusive with respect to the radioinduced aging hypothesis. (BBB)

35519 THE ROLES OF CELLULAR DIVISION AND MATURATION IN THE FORMATION OF PRECIPITATING ANTIBODY. Paul Urso and T. Makinodan (Oak Ridge National Lab., Tenn.). J. Immunol., 90: 897-907(June 1963).

The relative importance of somatic division and conversion of pyronophilic cells into mature plasma cells, in the secondary antibody response, was studied in the lymphoid cells of rabbits immunized with bovine serum albumin (BSA). The anti-BSA response by isolated cells was investigated with the use of tritiated thymidine as a marker in combination with the immunofluorescent technique and colchicine, a mitotic inhibitor. The cells were cultured in diffusion chambers implanted into x-irradiated rabbits and mice. The results showed that not only were antibody-containing cells dividing but that they were dividing at a rate significantly higher than that of the incompetent cells during the log phase of activity. The mean generation time was 12 hr during the log phase and 24 hr in the stationary phase. A direct correspondence was found between the rise in percentage of antibody-containing cells and rise in antibody titer of culture chamber fluid. All competent cells of the stationary phase were derived from precursor cells through somatic division. Cytomorphologic examinations of antibody-containing cells at intervals after antigenic stimulation suggest a gradual transition in the number and distribution of sites of antibody synthesis. It is speculated that these processes result from primary or secondary action of antigen upon the cell nucleus, and that the messenger RNA is first utilized by the ribosomes of the nucleolus. (BBB)

35520 THE EFFECT OF ACUTE RADIATION INJURY ON PHAGOCYTIC MECHANISMS OF ANTIBACTERIAL DEFENSE. Mary Ruth Smith, Diane O. Fleming, and W. Barry Wood, Jr. (Johns Hopkins Univ., Baltimore). J. Immunol., 90: 914-24(June 1963).

The influence of irradiation on in vivo phagocytic activity was investigated by irradiating mice with whole-body, 100–650 r doses of x rays and injecting them intramuscularly 72 hr later (the time of max radiation-induced leukopenia) with 1000 type I pneumococci. Results showed that the principal factor involved in the lowered resistance of the irradiated host is a marked depression in the mobilization of phagocytic cells at the site of the primary lesion. The delayed and diminished inflammatory response, which coincides with the postirradiation leukopenia, permits the pneumococci to reach a population density in the lesion ~1000 times greater than that observed in unirradiated mice. That the principal effect of acute radiation injury is upon the mobilization of exudate at the site of infection is supported by the observation that during recovery from acute radiation injury, there is a direct correlation between the peripheral leukocyte count and the efficiency of the tissue defenses. However, the possibility cannot be excluded that the relatively few leukocytes which are present in the circulation are so damaged that they are unable to penetrate the vessel walls or to migrate normally through the interstitial spaces of the infected tissues. The promptness with which the radiation effect on the bone marrow is reflected in the cellularity of the exudate was shown in an experiment in which an already established exudate was rapidly depleted in the peritoneal cavity when the supply of circulating leukocytes was cut off. (BBB)

35521 THE EFFECTS OF X IRRADIATION ON THE SPINAL CORDS OF NEONATAL RATS. I. NEUROLOGICAL OBSERVATIONS. Shirley Ann Gilmore (Univ. of Arkansas, Little Rock). J. Neuropathol. Exptl. Neurol., 22: 285-93(Apr. 1963).

One- to 21-day-old Sprague-Dawley rats received a single dose of 4430 r soft (50-kvp) x irradiation to a localized area of the body overlying the spinal cord. Neurologic examinations were made for several months. Over 70% of animals irradiated at 1 to 3 days of age showed persistent, abnormal neurological signs in contrast to 39% of those irradiated at 10 days of age, 17% of those irradiated on day 15, and 0% of those irradiated at 21 days of age. The latent period was 9 to 11 days for those irradiated at 1 to 5 days of age, 17 to 20 days for those irradiated at 10 days, and 28 to 32 days for those irradiated on day 15. Some animals in all groups remained apparently normal, and in groups irradiated at 5 days of age or more, some animals recovered after showing initial neurological alterations. The pattern of the neurological alterations varied but most common was flaccid paralysis with dragging of the hindlimbs. The onset of abnormal neurological signs was very sudden, in most cases occurring within a 12-hr period. Impairment in visceral function in some animals was shown by distention of the urinary bladder and constant, slight spilling of urine. The long ascending and descending pathways of the afflicted animals were initially judged to be intact, but the integrity of these was disrupted after 10 weeks postirradiation as seen by changes in response to painful, thermal, and vestibular stimulation. Histopathologic studies 10 weeks or more postirradiation revealed that the normal vertebral architecture in the irradiated cord had been replaced by chalky white, osseous material which had produced partial or complete transection of the spinal cord. The kidneys and/or adrenals were markedly reduced in size in some irradiated animals. Although it was previously demonstrated that administration of pentobarbital prior to x irradiation of guinea pigs abolished abnormal neurological signs and histological changes in cerebellum, anesthetized rats irradiated at 10 days of age showed a slightly higher incidence of neurological alterations than did the unanesthetized animals of the same age. Thus, it seems that anesthesia did not suppress the radiation injury to the central nervous system. It is concluded that age at time of irradiation is an important factor in determining incidence, severity, and course of subsequent neurological abnormalities. The time sequence of the progressive neurological changes suggests that these abnormalities may be related to two processes: a direct effect of irradiation on the nervous system as manifested as flaccid paralysis, and an indirect process related to alterations in the vertebral columns which, in turn, produce pressure upon or transection of the spinal cord. Disruption of long ascending and descending tracts observed during the latter part of the experimental period was probably the result of this second process. It is suggested that the nervous system may be very sensitive to radiation immediately after birth and may undergo sufficient change to render it radioresistant 15 to 21 days after parturition. (BBB)

35522 THE EFFECTS OF X IRRADIATION ON THE SPINAL CORDS OF NEONATAL RATS. II. HISTOLOGICAL OBSERVATIONS. Shirley Ann Gilmore (Univ. of Arkansas, Little Rock). J. Neuropathol. Exptl. Neurol., 22: 294-301 (Apr. 1963).

Histopathologic studies of the spinal cord were conducted on the rats irradiated with a single dose of 4430 r soft x rays. Inhibition of myelin formation was observed within the spinal cord in all irradiated areas, with apparently normal amounts of myelin above and below the lesion. No extensive change in myelin of the spinal roots was noted. There was a marked decrease in the number of neuroglial nuclei at the site of irradiation as early as 2 days postirradiation. Hypertrophy of astrocyte nuclei was present by 9 to 11 days postirradiation. There were no widespread alterations in ventral horn cells, which seemed to develop to the adult form as seen by their shape of the cell and accumulation of Nissl substance. Petechial hemorrhages were observed in both gray and white matter, most frequently in rats examined 9 to 11 days postirradiation, occasionally in those at 6 days, but never in those at 2 and 4 days after irradiation. Endothelial swelling was also noted at 9 to 11 days postirradiation. It was difficult to correlate these histopathological changes with the flaccid paralysis observed in the animals 9 to 11 days after irradiation: although all animals exhibited the histopathological changes, all were not paralyzed. Furthermore, the histopathological changes occurred very soon after irradiation, whereas paralysis was not evident until later (9 to 11 days postirradiation). The seemingly selective, destructive, early action of ionizing radiation on neuroglia observed here has not been previously described. This loss of both mature and immature forms of neuroglia was evident as early as 2 days postirradiation, the earliest period studied. There appeared to be a differential sensitivity of types of neuroglia to ionizing radiation. Oligodendroglia were more sensitive than astrocytes since astrocytes could be found in areas devoid of oligodendroglia throughout the entire experimental period. Although astrocytes were present, some differed from those in the control sections: nuclei were hyperthrophied and the processes as coarse and fibrillar. The inability to stain normal astrocytes in control sections under the same conditions suggests that impregnation by gold chloride is enhanced by irradiation. Widespread alterations in large ventral horn cells were not seen. After irradiation, some of the cells continued to develop and maturation, as seen by acquisition of Nissl substance, was not inhibited. In view of the marked paralysis in some animals, absence of lesions in somatic motor neurons of the ventral horn is surprising. (BBB)

35523 OBSTETRIC RADIODIAGNOSIS AND EMBRYONIC-FETAL RISK. P. Bailo and F. Nobili (Ospedale Maggiore, Bergamo, Italy). Minerva Ginecol., 13: 532-43(May 31, 1961).

The possible hazards to the fetus and embryo of diagnostic radiologic procedures during pregnancy are reviewed. In addition, 190 cases of congenital malformations, observed at the authors' clinic between 1950 and 1960, were examined in attempts to detect the possible etiologic role of prenatal irradiation in their development. The median age of the mothers was between 26 and 30 yr. Only 23% of the mothers reported having undergone radiodiagnostic tests during pregnancy. Among this group there were 6 infants with deformed feet, 5 with hydrocephalus, 4 with ancephalus, 3 with spina bifida, 3 with hare lip, 3 with penile hypospadias, 2 with umbilical hernia, 2 with cleft palate, and 1 each of aplasia of the cranial vault, myelomeningocele, polydactylism, syndactylism, congenital cardiopathy, and imperforate anus. An analysis of the time of irradiation during gestation in relation to the period of fetal development of the structures involved did not implicate radiation in formation of these anomalies, since all of the irradiated mothers received this treatment between the 4th and 9th months of gestation. Consanguinity, syphilis, and Rh incompatibility were present in many of these cases and may have accounted for some of these deformities. It is concluded that diagnostic radiology carried out after the 1st 3 months of pregnancy according to standard procedures are not harmful to the fetus or the mother. (H.H.D.)

35524 EFFECT OF X-IRRADIATION ON THE HEPATIC GLUCOSE-6-PHOSPHATASE ACTIVITY IN RAT. K. B. Lee (Chonnam National Univ., Kwangju, Korea) and H. J. Lee. J. Nucl. Sci., 2: 23-9(1962). (In English)

The effects of 200-1200 r whole-body x irradiation on the hepatic G-6-Pase activity in rats were observed and are discussed: the activity of G-6-Pase varied in rather wide limits by x irradiation, but did not depend on the dose. Hepatic G-6-Pase activity in both x irradiated and non-irradiated rats revealed no significant changes by the sex difference. In both x irradiated and non-irradiated rat liver, the activities of G-6-Pase increased by fasting during the exposure time, but the increase was apparently greater in the non-irradiated rat. The slight increase of G-6-Pase activity in the x irradiated rat can be explained by the increase in liver mass weight observed after x irradiation. On the other hand, it is suggested that the increase of liver mass after x irradiation might be due to the marked increase of liver glycogen content by x irradiation. It was concluded that x irradiation affects the action of the G-6-Pase, but the activity of G-6-Pase does not depend on the dose, and the change of G-6-Pase activity after x irradiation might be due to the secondary x irradiation effect. (P.C.H.)

35525 THE EFFECT OF X-IRRADIATION ON THE REGENERATION OF RHODOPSIN. S. H. Kang (Ewha Woman's Univ., Korea). J. Nucl. Sci., 2: 30-4(1962). (In Korean)

The test group and the control group consisted of five frogs (Rana nigromaculta 30-40 g), of the same weight respectively. The test group, which had been x irradiated, were adapted to light for two hours and then dark-adapted for another two hours. Under a dim red light (>650 mμ) the heads were cut off and the retinas were removed from the eyeballs. Then rhodopsin was extracted with 2% digitonin solution (pH = 7.2) for twenty hours at 0°C. The regeneration ratio of rhodopsin was calculated by measuring the optical densities before and after the illumination. The test group was irradiated with 800, 1000, 1200, and 1500 r respectively, and examined at 4, 24, 48, and 72 hr intervals. The doses, however, had no effect on the regeneration of rhodopsin in comparison with the control group. The test group was irradiated with 2000 r. After 4 and 24 hours there was no effect in the regeneration of rhodopsin. However, 48 hours later the amounts of rhodopsin started to increase, and 72 hours later there was a considerable increase of the regeneration of rhodopsin. Therefore it is considered that a certain secondary factor as a result of x irradiation promotes the regeneration of rhodopsin. (auth)

35526 PRELIMINARY REPORT ON THE EFFECT OF CYSTEINE ON THE RATE OF X-RAY INDUCED MUTATIONS IN DROSOPHILA MELANOGASTER. Y. K. Paik, T. S. Kim, and K. C. Sung (Yonsei Univ., Korea). J. Nucl. Sci., 2: 37-40(1962). (In English)

The protective effect of cysteine against the production of sex-linked recessive lethals in Drosophila sperm by x irradiation was investigated. It is shown that the cysteine injection prior to irradiation apparently reduced the production of sex-linked recessive lethals. The protecting action of cysteine can be ascribed to the oxygen starvation produced by its easily oxidized-SH groups during irradiation. (P.C.H.)

35527 BREEDING EXPERIMENT ON MUTATION INDUCTION BY IRRADIATION. 1. EFFECTS OF X- AND γ-RAY IRRADIATION ON CABBAGE SEEDS. D. W. Kim, Y. C. Kim, C. H. Lee, and K. W. Choe. J. Nucl. Sci., 2: 91-7(1962). (In Korean)

Studies were made on the effects of x and γ irradiation on dry cabbage seeds and the utility of artificially induced mutations in plant breeding was examined. The radiosensitivity of cabbage in the R_1 generation and the phenotypic mutation in the R_2 generation are discussed. Two varieties of Succession and Fuji Early were used. The seeds originated from the progeny of the same line in 1959 and thus would be expected to have a high degree of genetic uniformity. To have same moisture content, the materials were kept in a desiccator filled with $CaCl_2$ for six weeks before irradiation and were irradiated to the extent of 5 to 30 kr of x and γ radiation. Germination rate and number of true leaf were surveyed at 20 days after planting and it was found that no differences occurred among the treatment except 30 kr of γ-ray plot. Survival rate in a maturing season was irregular by treatments and most of the plants of 30 kr of γ ray died without reaching at maturity. Slowly growing conditions were generally observed in all treatments and this was more remarkable in γ ray plots rather than that of x ray. For flower induction 5 R_1 plants selected at random at all of the plots except 5 and 15 kr of both radiation were transplanted in earthen pots in a greenhouse without heat to obtain a chilling requirement. Fertility was decreased as dosage increased while frequency of abortive pollen was increased. This signifies a negative correlation. Fertility variations were observed among the varieties as well as treatments. In the comparison of fertility distribution in an interval of 0 to 10% with varieties, in γ-ray treatments, Succession and Fuji Early showed 72.4 and 51.4% respectively, and in x-ray treatments, 39.4 and 30.9%, respectively. In spite of the theoretical assumption that fertility should be variable as with proportion of abortive pollen, some extent of irregularity was observed. This seemed to be attributable to small number of materials and pollination error in the bud. In R_2 generation, various types of mutants such as chlorophyl deficiency, poly-branch, non-meristem, fascination, and dwarf type were observed. It was found in the γ-ray treatment that higher dosage showed higher percent of abortive pollen as well as lower percent of induction of mutants. From the results, it was assumed that the most effective dosage to induce a useful mutant would be 30 kr more or less of x radiation and 20 to 30 kr gamma radiation, respectively. (P.C.H.)

35528 STUDIES ON THE SKIN-DOSE MEASUREMENT WITH PHANTOM. J. W. Nam (National Inst. for Public Health Training, Seoul, Korea). J. Nucl. Sci., 2: 132-46 (1962). (In Korean)

A conventional method for skin-dose measurements was re-evaluated in order to solve the difficulties of radiophysical inspection. A comparison was made between the data obtained from a phantom and the skin, and the calibration factor was computed. Comparison was also made between the air-dose and skin-dose for the computation of the calibration factor. The effects of the scattered radiation from the phantom on the chamber were compared with that of the air-dose and the increment of the relative dose was evaluated. An attempt was made to clarify the effect of the scattered radiation by determining the saturation thickness of the phantom. Formulas for the computation of skin-dose from the exposure dose on the phantom as well as that for the computation of skin-dose from the exposure dose in air alone without using the phantom were derived. (P.C.H.)

35529 A METHOD FOR IMPROVING HOMOGENEITY AND IMPERMEABILITY OF P^{32} APPLICATORS. T. Holan,

I. Szantay, M. Miclutea, and Z. Uray. J. Radiol. Electrol. Med. Nucl., 44: 449-50(June-July 1963). (In French)

A method is described for preparing a P^{32} applicator with filter paper imbibed with 20% radioactive solution. The exposure time to persons in charge of the treatment is reduced if mark lines are drawn on the external surface of the applicator, lines that are continued on the patient's skin. The applicator retention on the diseases surface is obtained with fixation ribbons imbibed with polymethylmethacrylate. These ribbons are attached with adhesive plaster bands, so that a correct and stable position is maintained. (P.C.H.)

35530 X IRRADIATION AND THE SECONDARY RESPONSE TO TETANUS TOXOID IN MICE. J. C. Crook (Chemical Defense Experimental Establishment, Salisbury, Eng.) and C. E. Ford. J. Roy. Army Med. Corps, 108: 67-76(Apr. 1962).

In 1952 it was recommended that wounded soldiers who had been actively immunized should be given a dose of tetanus toxoid and not tetanus antiserum as had been the practice previously. However, in the event of nuclear warfare, wounded soldiers might be exposed to irradiation, which would be detrimental to toxoid treatment since irradiation inhibits antibody formation. To investigate the problem, male PCT mice were immunized with two doses of tetanus toxoid at a 6-week interval, and their immune response to the second dose was tested by challenge with tetanus toxin 14 days later. Whole-body x irradiation with 200, 350, and 500 rad was given at intervals, ranging from 35 days before the second dose of toxoid to 7 days after. The criterion of inhibition of immune response was the percentage of deaths and paralyzed survivals occurring on the eighth day. The secondary response to tetanus toxoid was shown to be radiosensitive and to depend largely on the dose of radiation; a dose of 500 rad produced ~50% inhibition. Radiation given from 35 days to 1 day before the second dose of tetanus toxoid produced most inhibition; when given 2 days after the second dose it was less effective, and it was ineffective when given 5 or 7 days after. In the 200-rad experiment there was no evidence of inhibition at all. It is concluded that the wounded soldier should receive a booster dose of tetanus toxoid as soon as possible after wounding and probable irradiation from an atomic weapon. If a delay of a day or two occurred, the irradiated soldier might be at a stage of marked inhibition of his secondary response. If it is assumed that these findings are capable of extrapolation to man, he would not be capable of responding fully to any active immunizing procedures for a period of a few weeks at least after irradiation. (BBB)

35531 THE OMENTUM AS REPAIR MATERIAL FOR THE BLADDER WALL AFTER RADIATION-INDUCED VESICOVAGINAL FISTULAS. I. Chiricuta and M. B. Goldstein. Krebsarzt, 16: 202-7(May 1961). (In German)

It is suggested that the omentum is useful for plastic repair of the bladder in cases of radioinduced vaginal fistulas of the bladder. This method requires no suture of the plastic repair material to the bladder; sutures are the critical factor in other surgical interventions for bladder fistulas, nor does the technique require extensive separation of the bladder from the subjacent tissue. Since the plastic material generously overlaps the aperture of the fistula on all sides, it is not necessary to wait for the fistula to develop fully. For large fistulas, reaching the aperture of the ureter, this operation offers the best solution: other complicated interventions, such as ureterocystostomy, unphysiologic methods, or implantation of the urethra in the colon, can be avoided. Since the technique does not require use of the wall of the bladder for closure of the fistula, it can be used in nearly all recurrent cases, even after other surgical methods have failed. In the case of fistulas caused by radiation and surgical treatment, the transabdominal approach allows examination of the pelvis and possible removal of cancer-bearing lymphatic glands. At the same time ureterolysis can also be carried out, in case the urethra should be contracted by periureteral sclerosis. Surgical procedures involved in the technique are described and illustrated with reference to a patient incurring bladder injury following 19,600-r irradiation for cervical carcinoma. (BBB)

35532 LETHAL DOSES OF IRRADIATION FOR LUMBRICUS. R. L. Hancock (Univ. of Chicago). Life Sci., No. 11, 625-8(Nov. 1962).

Irradiation effects in the phylum Annelida are almost entirely unknown, nor is it know why the $LD_{50/30}$ for amoebae is 100 kr, whereas mammals show LD_{50} doses of ~0.5 kr. To shed more light on comparative radiosensitivity, Lumbricus terrestris was irradiated at a rate of 1 kr/min with 250-kr x rays to total doses of 10 to 100 kr. No lethal effect occurs at 45 kr or below in Lumbricus, whereas a definite mortality occurs with 75 kr. All worms died within 2 months after 100 kr. The $LD_{50/35}$ and $LD_{100/87}$ are ~100 kr. This is in contrast to the mollusk Radix which has a $LD_{50/20}$ of 12 kr, while some coelenterates require 300 kr for lethal effects. The annelid Enchytraeus shows no apparent effect after 90 kr. It is suggested that some feature of biological organization, which has up to the present escaped discovery, may hold a clue to the fundamental nature of radiobiological action, and may explain the extremes of radiosensitivity present within a few selected invertebrate types. (BBB)

35533 MORPHOLOGICAL CHANGES IN ALBINO RATS IN REMOTE PERIODS AFTER Po^{210} ADMINISTRATION. V. A. Sanotskii and E. V. Erleksova. Med. Radiol., 8: No. 7, 71-7(July 1963). (In Russian)

Upon morphological investigation of organs of 24 albino rats subjected to a single Po^{210} administration (subcutaneously into the hip 0.005 and 0.0025 mC/kg) 282–590 days later tumors were found in the soft tissues of the hip, kidneys, perirenal fatty cellular tissue, and thyroid gland. Microscopic investigation disclosed that the tumors were cancers, sarcomas with metastases into the lung, heart, mesenteric lymph node, omentum, and adrenal gland. Histoautoradiograms confirmed the development of tumors from the tissues of organs where Po^{210} is retained protractedly, irrespective of its quantity. (auth)

35534 THE DOSE DISTRIBUTION IN SUPERFICIAL LAYERS OF THE TISSUE ALONG THE BEAM AXIS OF GAMMA-APPARATUS GUT-Co-400-1. V. A. Petrov, I. S. Osipov, P. S. Pivanova, and R. E. Novikova. Med. Radiol., 8: No. 7, 78-81(July 1963). (In Russian)

The results of investigations concerned with the distribution of doses in superficial layers of tissue along the axis of the gamma-apparatus beam are presented. (auth)

35535 VISUAL EFFECTS OF ROENTGEN RAYS. Mark D. Altschule. Med. Sci. (Philadelphia), 13: 388-90 (Mar. 10, 1963).

Evidence that the retinas of some animals have visual sensitivity to x rays is briefly reviewed. (BBB)

35536 GENETIC DAMAGE CAUSED BY IONIZING RADIATIONS. Ove Frydenberg (Univ. of Copenhagen). Medd. Sundhedsstyr., 116: 861-7(May 18, 1962). (In Danish)

35537 THE EFFECT OF X-RAY AND NUCLEAR IRRADIATION ON BAC. PERFRINGENS. REPORT I. THE CHANGE IN THE MORPHOLOGY AND CULTURAL CHARACTERISTICS OF BAC. PERFRINGENS TYPES A AND B INDUCED BY THE ACTION OF GAMMA-NEUTRON RADIATION. A. M. Pasechnik, M. D. Matveeva, and G. G. Tulina (Inst. of Microbiology, Academy of Sciences, Ukrainian SSR). Mikrobiol. Zh., Akad. Nauk Ukr. RSR, 25: 15(1963).

When C. perfringens were irradiated with doses exceeding $0.5 \cdot 10^3$ r, asymmetrical colonies with different shapes were formed (with split, paddle-like edges, smooth center and lacy edges, ameboid, and with intricate patterns) containing degenerative elongated cells. After several passages on Kitt-Tarozzi medium, the morphology of the cells was restored, but the shape of the colonies remained unaltered, being most frequently paddle-like. Change in the saccharolytic properties was manifested by the loss of the capacity of fermenting lactose or sucrose or both. Variants that had lost saccharolytic properties appeared after irradiation with large doses (1.10^6 to 2.10^6 r). (OTS)

35538 LOW-VOLTAGE ELECTRON BEAM IRRADIATION OF NORMAL AND 5-BROMOURIDINE DEOXYRIBOSIDE-TREATED L-P_{58} MOUSE FIBROBLAST CELLS IN VITRO. Arthur Cole, Ronald M. Humphrey, and William C. Dewey (Univ. of Texas, Houston). Nature, 199: 780-2(Aug. 24, 1963).

Low-voltage electron beams were used to irradiate to selective depths within mouse fibroblast cells grown in tissue culture, with and without the addition of 5-bromouridine desoxyriboside (BUdR) in an investigation of the role of nuclear and chromosomal damage in radiation killing of mammalian cells. The electron beam irradiation system is described and problems of dosage measurement are discussed. Representative plots of the survival data indicate that two mechanisms may be involved in the radiation killing of mammalian cells, one of which involves chromatin located on or near the nuclear membrane and is potentiated by BUdR directly associated with desoxyribonucleic acid (DNA) and another that does not involve DNA. (C.H.)

35539 INDUCTION OF MUTATIONS IN BARLEY WITH ULTRA-VIOLET RADIATION. A. T. Natarajan and Satya Nirula (Indian Agricultural Research Inst., New Delhi). Nature, 199: 822-3(Aug. 24, 1963).

Soaking of barley seeds in water for 4 hr and oxygen saturation of seeds were effective in increasing the mutation rate in barley seeds exposed to uv radiation when the treatment was given before irradiation. No effect was observed when the seeds were treated after radiation exposure. (C.H.)

35540 IN VIVO INVESTIGATION OF THE REMOVAL OF TRACE ELEMENTS FROM NUCLEIC ACIDS OF YEAST BY IONIZING RADIATION. Hans Altmann, Gerhard Stehlik, and Karl Kaindl (Inst. of Biology and Agriculture, Reactor Center, Seibersdorf, Austria). Nature, 199: 823(Aug. 24, 1963).

Neutron activation analysis was used to measure the content of certain trace elements in yeast nucleic acids before and after exposure to various doses of Co^{60} γ radiation ranging from 0 to 24,000 rads. Data are presented for Cu, Mn, Ni, and Zn. A decrease of the trace element content at doses above 8000 rads was observed. Possible reaction mechanisms involved are discussed. (C.H.)

35541 THE DYNAMICS OF THE DEVELOPMENT OF GIANT CELLS AFTER IRRADIATION IN VITRO AND THE EFFECT OF CYSTEAMINE ON THESE CELLS. M. Klímek and M. Vlašínova (Inst. of Biophysics, Czechoslovak Academy of Sciences, Brno). Neoplasma, 10: 221-9(1963). (In English)

The dynamics of the formation of giant cells of the HeLa strain and the effects of cysteamine on the cells prior to irradiation were studied. The application of cysteamine prior to irradiation was found to have a protective effect. The enlargement-rate of the protected cells was significantly lower than that of the unprotected cells. Analysis of the cell population showed that cysteamine inhibits the formation of the largest cells in irradiated populations. The question of the duration of the effect, respectively the ability of protected giant cells for further reproduction, was not clarified. (P.C.H.)

35542 AN ATTEMPT TO INCREASE THE RADIOSENSITIVITY OF EXPERIMENTAL TUMOURS BY INDUCING A STATE OF HYPERMETABOLISM. E. Siracká, F. Knotz, and L. Šándor (Inst. of Cancer Research, Bratislava). Neoplasma, 10: 231-5(1963). (In English)

The results of an attempt to increase the radiosensitivity of Yoshida and Jensen sarcomas transplanted to rats, in an hypermetabolic state induced by the application of 3-5-3-L triiodothyronine are presented. A statistical evaluation of the results confirmed increased radiosensitivity of the tumors in the hypermetabolic state. (auth)

35543 TREATMENT OF THORIUM DIOXIDE GRANULOMAS OF THE NECK. B. S. Levowitz (Downstate Medical Center, Brooklyn), R. E. Hughes, and T. C. Alford. New Engl. J. Med., 268: 340-2(Feb. 14, 1963).

The incidence of malignancy following the use of ThO_2 as a contrast medium (Thorotrast) is discussed and the case history of a patient developing a cervical granuloma 20 yr after its use for arteriography is presented. Such granulomatous formations have been observed to accompany accidental extravascular injections of the compound into the groin, antecubital fossa and neck. In these areas cells injured or destroyed by α activity provoke an intense connective-tissue response. The result is a painful, enlarging fibrous mass, which eventually leads to contracture and limitation of function. Although total excision of an accessible lesion of an extremity is generally successful, surgical treatment of the cervical tumors has been discouraging. Since the effects of radiation injury are cumulative, the possibility of further tissue damage from small deposits beyond the limits of resection was considered remote within the lifetime of the patient. A brief review is presented of the symptoms and treatment of 45 patients with cervical perivascular deposits of ThO_2 and symptomatic granulomas reported in the English literature. From these reports it is evident that both the supporting and specialized soft tissues of the neck are susceptible to chronic radiation injury. The radiation-induced pharyngoesophageal lesions include indolent ulcers, fistula formation, and stenosis. Necrosis of the epithelium, together with an impaired blood supply and cicatricial reaction, account for these changes. The combined effect of endothelial damage from ionizing radiation and vascular constriction from the enveloping mass fibrosis also lead to gradual thrombosis and occlusion. (BBB)

35544 EMBRYOPATHY DUE TO IONIZING RADIATIONS. J. Francois, C. Hooft, R. de Blond, and F. de Loore (Universitè, Ghent). Ophthalmologia, 143: 163-86 (1962). (In French)

Studies indicating a causal relation between irradiation of the pregnant female and malformation of the offspring,

both in animals and in humans, are reviewed, and the case of a girl, hospitalized at the age of three for psychomotor retardation, is described. Previous history of the case revealed that the mother received a radiologic examination of the abdomen for gastrointestinal infection during the second month of pregnancy. The apparently normal female infant showed convulsions at 3 months, and at 15 months was operated on for congenital unilateral cataract. Pediatric examination after hospitalization revealed: microcephalia and right facial paresis; malformation of the central nervous system with deafmuteness and mental retardation; slight malformation of the heart, producing a murmur; ocular malformation: microphthalmia, congenital cataract in the right eye and bilateral retinal dystrophy. Correlation of this study with experimental research in this field led to the following conclusions: heavy direct irradiation of the embryo in the first months of pregnancy frequently causes embryopathy, characterized by marked congenital malformations of the central nervous system, eyes, bones, and genitourinary system; irradiation is most dangerous in the first 3 months of human gestation, and especially from the third to the ninth or tenth week, when the central nervous system and eyes are particularly sensitive; to cause embryopathy, the x-ray dose must exceed 50 r; any irradiation during the first 3 months of pregnancy be avoided, and irradiation of the pelvis of women of childbearing age be limited to the first 2 weeks after menstruation. (BBB)

35545 VISUAL DEFICIT IN ALBINO RATS FOLLOWING FETAL X IRRADIATION. Dirk H. Van Der Elst, Paul B. Porter, and Joseph C. Sharp (Northwestern Univ., Chicago). Percept. Motor Skills, 16: 291-4(Feb. 1963).

To investigate the effect of radiation on visual ability, five groups of rats on the 15th day of gestation received x irradiation in doses of 0, 50, 75, 100, or 150 r at 50 r/min. Two-thirds of the newborn rats died or were killed and eaten during the first postnatal week. The 75- and 50-r groups were lost entirely. The cannibalism occurred in all groups, so that its cause was uncertain. The remaining rats, which as fetuses had received 0, 100, and 150 r, were tested for visual discrimination in a water-flooded T. All 3 groups discriminated a lighted escape ladder from the unlighted arm of the T with near-equal facility. Thereafter, as the light was dimmed progressively, performance declined in relation to dose. With the light turned off, but the bulb and ladder visible in ambient illumination, the 150-r group performed at chance, the 100-r group reliably better, and the control group better still. Thus, in the more precise task the irradiated animals failed. Since irradiation on the 15th day primarily damages the cortex, central blindness seems the most likely explanation. All animals had previously demonstrated their ability to solve the problem conceptually; hence a conclusion of visual deficiency seems justified. The similar performances of all groups during the easiest light discrimination test showed that the heavily irradiated and severely injured animals of the 150-r group were nontheless able to learn readily. Contrary to earlier studies in which irradiated rats were retarded in discriminating a light in a Skinner box, present tests reveal impairment neither in learning rate nor light discrimination. (BBB)

35546 RADIATION NECROSIS OF THE CHEST WALL: FULL-THICKNESS RECONSTRUCTION WITH PEDICLE FLAP AND DICED HOMOLOGOUS CARTILAGE OVER THE PERICARDIUM COMPLICATED BY CARDIAC ARREST. Thomas D. Rees (New York Univ., New York). Plastic Reconstruc. Surg., 28: 67-71(July 1961).

Successful repair by plastic surgery of nonhealing ulceration of the chest wall, induced by radiotherapy for breast cancer, is described. Reconstruction of the chest wall defect by pedicle flap coverage was carried out. Radiation injury extended through the entire thickness of the chest wall and osteoradionecrosis of the ribs was present. Reconstruction with thoracoabdominal tube was considered to be the best technique, so a 4- by 9-in. tube pedicle was constructed. The underlying donor wound of the pedicle was covered with a split-thickness skin graft. Healing was without incident, and ~3 weeks after formation, the inferior end of this tube pedicle was migrated to the left epigastrium as an intermediate step. Healing was uncomplicated, and the lateral attachment of the pedicle was partially severed. Three weeks later, resection of all avascular tissue along with portions of the fourth and fifth ribs was carried out. This created a full-thickness chest wall defect measuring 4 by 6 in., with the anterior surface of the pericardial sac exposed in the wound. The end of the abdominal tube pedicle was elevated from its bed, rotated into position, and sutured to the healthy margins of the chest wall defect. The exposed subcutaneous fat of the undersurface of the pedicle was placed in juxtaposition to the pericardium. A split-thickness skin graft was cut from the skin of the left thigh and draped over the pedicle flap donor wound. All sutured wounds healed per primum and the entire skin graft survived. The inferior inset of the tube pedicle was cut free and the pedicle flap was tailored into position 6 weeks later. The patient was discharged from the hospital in good condition and engaged in normal activities. An attempt was made to provide protection for the heart beneath the pedicle inset by introduction of diced homologous cartilage grafts, just beneath the skin of the pedicle flap. This healed with the formation of a thick fibrocartilaginous structure providing some protection for the pericardial contents beneath. (H.H.D.)

35547 THOROTRAST GRANULOMA OF THE PHARYNX WITH LEFT TOTAL RECURRENT PARALYSIS, 18 YEARS AFTER ANGIOGRAPHY. J. Kuilman. Pract. Oto-Rhino-Laryngol., 24: 121-4(1962).

Development of tumors following use of Thorotrast (colloidal ThO_2) as a contrast medium for arteriography is reviewed, and a new case is presented. It concerns a 26-yr-old man who at the age of 7 yr was subjected to cerebral arteriography because of a suspected brain tumor. Symptoms included persistent hoarseness and recurrent nasopharyngeal infections. Inspection of the pharynx revealed a smooth diffuse swelling of the left posterior hypopharynx, hard on palpation, not painful, and not connected with the mucousal lining. It resembled an osteoma of fibroma, originating from cervical vertebrae. X-ray photos showed a dense oblong contrast shadow from the base of the skull down to the neurovascular bundle along the left carotid artery. Re-examination at regular intervals, after 2 yr did not show any increase of the pharyngeal swelling. Excision of the granuloma was impossible because of its diffuse localization amid vital structures. This case of granuloma of the hypopharynx with left paralysis of the recurrent nerve, occurring 18 yr after carotid arteriography from paravascular spilling of Thorotrast into the tissues around the neurovascular bundle, illustrates the hazards of this contrast medium and the importance of eliciting a history of its use in unexplained vocal cord paralysis. (BBB)

35548 DEPENDENCE OF FREQUENCY OF X-RAY-INDUCED CHROMOSOME ABERRATIONS OF DOSE RATE IN THE CHINESE HAMSTER. J. Grant Brewen (Johns

Hopkins Univ., Baltimore). Proc. Natl. Acad. Sci. U. S., 50: 322-9(Aug. 15, 1963).

The observed frequency of chromatid aberrations was different at each of three dose rates used in the irradiation of the corneal epithelium of the Chinese hamster. The difference was manifested in the frequency of chromatid deletions as well as chromatid exchanges. When the corneal epithelium was treated with puromycin at the three dose rates, the same frequency of aberrations was observed at all three dose rates. The frequency was the same as that observed at the highest dose rate without treatment with puromycin. Puromycin inhibits protein synthesis, which is known to be necessary for the rejoining of chromosomal breaks. Therefore, it appears that the effect of dose rate is a differential effect on the rejoining system. (P.C.H.)

35549 INACTIVATION OF BACTERIOPHAGE BY CHLOROFORM AND X IRRADIATION. Irene M. Cotton and Lloyd S. Lockingen (Univ. of Texas, Austin). Proc. Natl. Acad. Sci. U. S., 50: 363-7(Aug. 15, 1963).

The results of experiments on the relation between chloroform and x-ray inactivation of T2r phage are reported and conditions under which the lethal effect as judged by surviving fraction following a given dose of x rays can be increased by as much as 500,000 times in the presence of small amounts of chloroform are described. It was found that the presence of chloroform during irradiation significantly reduced the surviving population of T2r bacteriophage. However chloroform does not irreversibly sensitize the phage to subsequent irradiation. When irradiated phage were placed in irradiated salts-chloroform solution, there was a significantly greater inactivation of the bacteriophage than with nonirradiated phage in irradiated M-9 salts-chloroform. It was concluded that chloroform is active directly or catalytically in the production of toxic products in the solvent. (P.C.H.)

35550 CARCINOMA OF THE RECTUM FOLLOWING IRRADIATION OF CARCINOMA OF THE CERVIX. Joe C. Smith (University Coll. Hospital Medical School, London). Proc. Roy. Soc. Med., 55: 701-2(Aug. 1962).

Three case histories are presented relating development of rectal cancer 20 yr after combined Ra and x-ray treatment of cancer of the uterine cervix. Radiation doses received by the three patients (Ra + x rays) were: 6667 mg-hr + 2400 r, 4900 mg-hr + 4000 r, and 8100 mg-hr + 1220 r. The rectal tumors were first observed 19, 12, and 20 yr after radiotherapy. It was relatively easy to differentiate between the second primary tumor and a late recurrence of the original tumor. In all three cases, the initial tumor was a squamous cell carcinoma and the subsequent one an adenocarcinoma. Histologically, these are separate primary tumors. Perirectal induration was noted in the patients, and in two it was thought to be due to extension of the carcinoma. Todd previously described the perirectal induration as the extrinsic reaction. Evidence of early damage by irradiation was shown by the development of a stricture in Case 1 and a vesicovaginal fistula in Case 3. It is difficult to be certain that these rectal tumors are related to irradiation and did not occur by coincidence. (BBB)

35551 FERTILITY OF DOGS AFTER RECOVERY FROM "LETHAL" EXPOSURE TO RADIATION. B. Hager, E. Thomas, and J. W. Ferrebee (Mary Imogene Bassett Hospital, Cooperstown, N. Y.). Radiobiol. Radiother., 3: 1-3(1962).

Six dogs were given a super-lethal wholebody dose of Co^{60} γ radiation ranging from 600 to 1800 r, after which they were protected by injections of autologous bone marrow. Not only were the experiments successful in increasing survival of the animal, but also the reproductive capacity was restored. Reproduction, however, ceased within 6 months to 2 years. Eventually, the most offsprings were stillborn. This is explained by the appearance of latent damage in apparently healthy animals. (Atomdokumentation, 4 No. 15, Dec. 1962)

35552 DAMAGE AND REPAIR OF THE GASTROINTESTINAL TRACT AFTER SUPRALETHAL RADIATION. EXPERIENCE WITH DOGS RECEIVING 1800 TO 2400 ROENTGENS OF WHOLE-BODY GAMMA RADIATION. E. B. Hager, J. W. Ferrebee, and E. D. Thomas (Mary Imogene Bassett Hospital, Cooperstown, N. Y.). Radiobiol. Radiotherap., 4: 1-11(1963). (In English)

Fifty-five young dogs were exposed to Co^{60} gamma radiation. After whole-body exposures of 1,800 to 2,400 r they were given supportive therapy: fluids, antibiotics, and fresh blood, and intravenous infusions of homologous or antologous marrow. Four with functioning grafts of homologous marrow are alive and well 15, 16, 19, and 29 months following exposure. Survival in the others ranged from 3 days to 7 months. No clinically significant gastrointestinal lesion attributable to radiation damage was recognized at autopsy in animals that survived 3 or more weeks. Regeneration of intestinal mucosa was observed in all but one. Repair was prompt, virtually complete by the ninth day post-radiation. The pancreas was abnormal in six dogs with acute hemorrhagic pancreatitis in one and atrophy and exocrine deficiency in five. Disturbance of gastrointestinal function and structure increased with radiation dosage and radiation dose rate. At 1800 r, given in successive daily doses of 600 r at 2 to 7 r per minute, vomiting and diarrhea were absent. With 1800 r given continuously vomiting and diarrhea occurred and were progressively more severe and more early in occurrence as dose rate was increased from 2 to 5 to 18 r per minute. Dehydration and collapse in 3 or 4 days were frequent following 2000 to 2400 r given continuously at 12 to 18 r per minute. Anorexia and weight loss occurred in all irradiated dogs a few days after exposure. After regaining appetite and weight, survivors with homologous marrow grafts experienced in the fourth or fifth week a recurrence of anorexia and weight loss that was presumably due to graft versus host reaction. Histologic change assignable to this reaction was not recognized at autopsy. (auth)

35553 IN VITRO SURVIVAL OF RAT BONE MARROW AND MOUSE EHRLICH ASCITES TUMOUR CELLS IN FLUID MEDIA. A. Michaowski and J. Jasińska (Inst. of Oncology, Warsaw). Radiobiol. Radiotherap., 4: 25-8(1963). (In English)

The modification of earlier methods of bone marrow and mouse Ehrlich ascites tumor cells maintenance in fluid medium in vitro is described. (auth)

35554 THE INFLUENCE OF SERUM WITH LOCALLY IRRADIATED RATS ON THE JENSEN-SARCOMA IN VITRO. 1. COMMUNICATION: THE INFLUENCE ON THE GROWTH OF THE JENSEN-SARCOMA OF THE SERUM OF SINGLE DOSE IRRADIATED RATS. H. Wagner (Humboldt-Universität, Berlin). Radiobiol. Radiotherap., 4: 29-33(1963). (In German)

The serum of rats locally irradiated influences the growth of the Jensen sarcoma in vitro. The effect influencing growth is introduced by a retardation-reaction followed by a reaction stimulating growth. The retardation-activity as well as stimulating effect of the serum depends on the time

after the irradiation. The retardation-action stands in a direct relation to the applied dose. With its heightening, the retardation-effect of the serum grows stronger on the tissue-cultures. The possible connections of the growth-influencing reactions and the biologically active radioinduced products are discussed. (auth)

35555 ON THE EFFECT OF IONIZING RAYS ON THE NUCLEAR APPARATUS OF ASCITES-TUMOR-CELLS. H. Klug (Humboldt-Universität, Berlin). Radiobiol. Radiotherap., 4: 35-47(1963). (In German)

The ascites cell nuclei of a lymphosarcoma in white mice were studied after x irradiation using electron and light microscopy. Two types of cells could be detected after irradiation that were not observable in nonirradiated tumors. One type of white cell has a large chromatin-poor cell in which one or more rather large nucleoli are present. A smaller dark cell has a more highly colored nucleus in which no nucleolus is evident. The number of white cells in the first phase is considerably larger than the number of dark cells, but by the third day they are almost equal in number. With the electron microscope the cells with one or more nucleoli can be distinguished, but in the small-cell type only a nucleostructure of the nuclear membrane can be observed. The nucleoli have a compact ultrastructure formed of subradiomicrographic granula which frequently show different electron density and a luminosity generally in the form of vacuoles. In many cells some nucleoli show a partial structural modification, but in others the complete nucleolus is entirely altered in structure and is surrounded by a membrane-like envelope. Possible changes of the double-contoured membranes were not proven. The results are discussed. (tr-auth)

35556 FURTHER RESULTS ABOUT THE RADIATION PROTECTIVE EFFECT OF STEROID HORMONES. E. Baudisch, Seyfarth, and Vetterlein (Friedrich-Schiller-Universität, Jena, Ger.). Radiobiol. Radiotherap., 4: 57-67(1963). (In German)

Adrenocortico hormone (ACTH) and the extract of the adrenal cortex increased the rate of survival of rats irradiated with 650 r x radiation over the whole body. The number of the surviving animals was doubled when compared to the control group. When using young animals and older or emaciated rats, an effect of protection could not be proved. Those animals died even earlier. The death of the animals of the control group did not continually result during the time of observation of 30 days, but it resulted with three summit points. The protective effect showed especially in a diminishing of the second maximum of dying at the end of the second week after irradiation but came also to the expression at the beginning of the fourth week, the third summit point. It is evident that male rats are more sensitive to x rays than female ones. The weight curves show a retarded decrease of weight after treatment with ACTH and cortineurin in the first week and in the third week an increase opposite to a weight decrease of the control animals. Increase of weight is valued as a prognostically favorable token. Male rats show a higher loss of weight besides the increased x-ray sensitivity and stronger changes of serum protein. The radioinduced dysproteinemia is strengthened by ACTH and cortineurin. Albumin and gamma globulin reduction brings about the death of the animals. The different results in the protection tests with ACTH and adrenal-cortex hormone are attributed partly to the different mixing of the animal material without paying attention to the different sensitivity of male and female animals. The common state and the age as well as the radiation and hormone dose and the time of the hormone application also play an important part in results. (auth)

35557 THE PROTECTIVE EFFECT OF ULTRAVIOLET-IRRADIATION WITH ROENTGEN IRRADIATED MICE. E. Soevényi, K. Rák, F. Krizsa, and I. Cserháti (Röntgenklinik und der I. Medizinischen Klinik, Szeged). Radiobiol. Radiotherap., 4: 69-72(1963). (In German)

Whole-body x irradiation of 300 r did not cause thrombopenia in mice exposed 24 hours earlier to UV irradiation. With 500, 550, and 600 r the rate of the surviving ones was significantly greater when 48 and 24 hours earlier UV irradiation had taken place. The average duration of survival was lengthened, too. Results indicate a protective effect of the UV irradiation besides influencing the number of the thrombocytes injured by x rays. (auth)

35558 RADIATION DOSE TO THE EYES WITH CONVERGENT IRRADIATION IN THE AREA OF THE EPIPHARYNX. H. Buttenberg and F. Schiffers (Röntgen-Radium-Institut der Medizinischen Akademie Erfurt, Ger.). Radiobiol. Radiotherap., 4: 91-8(1963).

Procedures are described for protecting the eye during convergent radiotherapy of malignant tumors of the epipharynx. Results are reported from measurements on phantoms using appropriate isodose and exact adjustment of the x ray beam. It is pointed out that covering the eye during irradiation reduces the radiation dose to the lens, but that an exact combination of focus and field is required to avoid damage to the optic nerve and the possible formation of radioinduced cataracts. (C.H.)

35559 PULMONARY VARIABILITY AFTER COBALT^{60} IRRADIATION AND MOVEMENT-IRRADIATION OF CARCINOMA OF THE OESOPHAGUS. F. Sieber and W. Clausnitzer (Medizinischen Akademie "Carl Gustav Carus", Dresden). Radiobiol. Radiotherap., 4: 99-105(1963). (In German)

Lung reactions were observed in 15 of 25 patients with carcinoma of the esophagus after treatment with telecobalt γ radiation. Mild reactions soon disappeared, but severe reactions resulted in the formation of fibrosis. Telecobalt therapy spares the skin and bones, in contrast to conventional x ray depth therapy, but this is not the case with tissues of the lungs. (C.H.)

35560 PREOPERATIVE IRRADIATION OF THE PARAMETRIA WITH OPERABLE CERVICAL CANCER WITH MOVEMENT-IRRADIATION. N. Van Hai, F. Held, and R. Schwarz (Universitäts-Frauenklinik, Rostock, Ger.). Radiobiol. Radiotherap., 4: 107-11(1963). (In German)

Preoperative irradiation was carried out in patients with Stage I or II cervical cancer. Procedures used for moving beam irradiation of two fields are described. A total focal dose of approximately 1500 r was administered in fractionated doses of 200 r during a period 6 to 8 days before the operation. No complications due to irradiation developed during one year. Results of the treatment on the cancers were not available. (C.H.)

35561 THE EFFECTIVENESS OF ADMINISTERING OXYTETRACYCLINE, VITAMIN B_{12}, AND FOLIC ACID IN THE RECOVERY FROM POSTIRRADIATION LEUCOPENIA. J. Surynek, P. Mach, and J. Dressler (Veterinary Coll., Brno). Radiobiol. Radiotherap., 4: 125-7(1963). (In English)

The administering of oxytetracycline, vitamin B_{12}, and folic acid is efficient in the recovery from postirradiation leucopenia in whole-body irradiated chicks. Oxytetracycline and vitamin B_{12} combined influenced especially the number of heterophils, and the addition of folic acid resulted in a significant rise of the absolute lymphocyte count. (auth)

35562 ON RADIATION-CONDITIONED INJURIES IN THE BONY SKELETON. F. Wachtler (Universität, Vienna). Radiol. Austriaca, 12: 253-74(1961).

The literature relating to radiation injuries of bone is reviewed, and nine new cases of radioinduced bone damage are described. Osteoradionecrosis originating both from external irradiation and from internal radioisotopes is discussed with reference to different skeletal regions. Survey of a large number of cases shows that radiation treatment of gynecologic cancer, with parametrial doses of 3000 to 7000 r from Ra or x rays, results in fractures of the femoral neck in 1 to 2% of the cases. Three such cases are described in detail. This type of fracture usually occurs within 3 yr of irradiation but may be delayed for as long as 10 yr. Mandibular radionecrosis has been described in 300 patients treated for tumors around the jaw, and two new cases are cited. Injury to the ribs is frequent in patients receiving thoracic radiotherapy, but radioinjury of the cranium is relatively rare, although one new case is cited of an osteolytic lesion following 1400-r irradiation for a brain tumor. Pathologic fractures have been observed in ⅓ of persons with Ra accumulations of 0.7 to 23 μg, 1 μg of Ra giving an estimated 20-yr dose of 16,640 rem. Induction of osteogenic sarcomas as a result of irradiation appears to require doses exceeding 5000 r, but in two exceptions doses of 1000 and 1500 r may have been responsible. Inhibition of bone growth in children may result from lower doses of radiation. (BBB)

35563 VARIATIONS IN THE CONTENT OF CEREBRAL ATP AFTER IRRADIATION WITH X RAYS AND THEIR SIGNIFICANCE. Aldo Rabassini (Università, Padua). Riv. Sper. Freniat., 85: 201-15(Mar. 31, 1961).

Changes in the concentrations of adenosine tri-, di-, and monophosphates (ATP, ADP, AMP) and the activity of ATPase in the brain of rats exposed to x rays were studied. Whole body, single doses of 1000 r were given 1, 3, 5, and 10 days prior to assay of the brains, which were frozen at -79°C immediately after removal. At this temperature the tissue could be stored until assay of the nucleotides in homogenates by spectrophotometric methods. The brain ATP content, 0.67 moles/g fresh tissue in unirradiated controls, did not change until the 3rd postirradiation day, when it began to decline until reaching a level of 0.35 moles/g on the 10th day. ADP, initially 0.93 moles/g, declined progressively throughout the observation period, reaching 0.65 on the 10th day. AMP also declined, from 0.25 in controls to 0.15 on the 10th day. Average values for the nucleotide contents of pathologic human brains are also tabulated, including samples from schizophrenic cases and brain tumors (angiomas, gliomas, astrocytomas, medulloblastomas). ATP and ADP content tended to be lower and AMP content higher in schizophrenic brain than in tumor tissue. When rats were irradiated with increasing doses of x rays between 600 and 1000 r, and the brains assayed for ATPase activity over the next 16 days, a decline in this activity in a dose-dependent way was noted. After 8 days the 1000-r dose caused a 50% decline in ATPase activity. With this dose the activity fell linearly with time over the 1st 11 days postirradiation. Much less decline in activity was noted after the sublethal 600-r dose. (BBB)

35564 IS IT POSSIBLE TO DETERMINE THE RADIATION DOSE APPLIED ON A PATIENT IN FLUOROSCOPY ON THE BASIS OF A NOMOGRAM? W. Schmitz and J. Klemm (Universität, Munich). Roentgen Bl., 16: 219-26(July 1963). (In German)

A comparison was made between the radiation dose applied on a patient in fluoroscopy and calculated with the aid of a nomogram, and measurements carried out with various types of instruments. Considerable differences were found due to the fact that the nomogram fails to take a number of decisive factors into consideration. Beyond that, intensive deviations may also occur between the scale values on the control desk and the electric data actually present on the tube. For that reason, the nomogram permits only a rough estimation, which makes it necessary either to regularly measure the dose or to exactly determine the dosage at least in regular intervals. (P.C.H.)

35565 LOW DOSE RADIATION OF THE DEVELOPING BRAIN. Samuel P. Hicks and Constance J. D'Amato (Univ. of Michigan, Ann Arbor). Science, 141: 903-4(Sept. 6, 1963).

X irradiation administered in single doses of 10 to 40 r had a widespread effect on the developing rat brain. It first diminished the formation of cytoplasmic basophilic material in the nerve cells and inhibited their growth. Single doses of 20 to 40 r caused permanent alterations of individual nerve cells, and interfered with their organization into neuronal assemblies, such as layers of the cerebral cortex. (auth)

35566 ACUTE LEUKEMIA FOLLOWING I^{131} THERAPY. Michael J. Moore. Southern Med. J., 55: 81-3(Jan. 1962).

A 70-yr-old hyperthyroid woman received 11.83 mc I^{131}, and acute myeloid leukemia was diagnosed 3½ yr later. It was estimated that the thyroid gland received a much greater amount of radiation than the remainder of the body, varying between 1 and 3 rad/μc administered (11,890 to 35,670 rad), and that she received a total of 4.8 to 10.4 rad to her bone marrow and ~6 to 13 rad of whole-body radiation. A review of patients receiving spinal irradiation for ankylosing spondylitis revealed that the dose to the spinal marrow which was needed to double the expected incidence of leukemia (to increase it by 0.5 cases per 10,000 annually) is ~94 r. This survey indicated that the incidence of leukemia with a 5-r exposure, for example, would be increased by 5%. Since a rad is approximately a 7% larger unit than a roentgen, the woman is estimated to have received ~5.3 to 12.8 r to her bone marrow. A review of the literature showed that there have been 11 cases of leukemia complicating radioactive iodine therapy and one case of lymphoma. A table is given relating the total dose and the time elapsing until the diagnosis of the leukemia or lymphoma. (BBB)

35567 MODIFICATION OF PREMUTATIONAL RADIATION DAMAGE IN DROSOPHILA. F. H. Sobels (State Univ., Leiden). Strahlentherapie, Sonderbaende, 51: 197-212(1962).

Previous studies showed that post-treatment with cyanide results in a significant increase of the frequency of sex-linked lethals after exposure of male flies to x rays given at a high dose rate. The effect is restricted to stages with peak sensitivity to radiation, presumably corresponding to spermatids and possibly late spermatocytes. Data from combined lethal and translocation experiments and the finding that post-treatment also enhances the mutation rate in a ring-shaped X chromosome provided independent evidence that the increase in lethal frequency due to cyanide involves gene mutations and possibly small delections. Further studies were conducted on changes of radioinduced mutation frequencies in successive stages of Drosophila spermatogenesis after post-treatment with both HCN and N_2, after dose fractionation, and after pretreatment with

both chloramphenicol and ribonuclease. Except for the latter experiments all exposures were given at the high dose rate of 45 r or 55 r/sec. Post-treatment with cyanide may lead to either an increase or a decrease of the mutation rate in stages with peak sensitivity. Post-treatment with purified N_2 increases the mutation frequency in spermatids, meiotic stages, and spermatogonia. Fractionation of the dose lowers the mutagenic effect of radiation in stages with peak sensitivity. In addition to this effect, dose fractionation followed by post-treatment with N_2 reduces the mutation frequency in spermatogonia. Pretreatment with chloramphenicol decreases the mutation frequency in spermatids, spermatocytes, and late spermatogonia, whereas an increase was observed in mature sperm. Pretreatment with ribonuclease likewise results in raising the radiation-induced mutation frequency in mature sperm and in lowering that in spermatids. It is concluded that in Drosophila males, modification of premutational damage is possible in spermatids, meiotic stages, and perhaps in spermatogonia. It appears that, as in paramecium, two contrasting processes are involved, one being associated with the rate of disappearance of premutational damage, the other with the rate required for its fixation to mutation. The observations after pretreatment with chloramphenicol and ribonuclease in sperm and spermatids, suggest that protein synthesis is involved in the different radiosensitivities of these two stages. (BBB)

35568 THE SIDE REACTIONS IN IRRADIATION AND THEIR TREATMENT. Adolf Moreczek and Klaus Neumeister (Strahleninstitut und der Strahlentherapeutischen Klinik der Medizinischen Akademie, Magdeburg, Ger.). Strahlentherapie, 121: 349-64(July 1963). (In German)

A survey is given concerning the possibility of unwanted reactions and damage occurring during radiation therapy. Many observations are based on clinical experience. It is to be expected that with further development of radiation biology it will be possible to work out new treatment methods based upon exact research results. (230 references.) (auth)

35569 EARLY AND LATE INJURIES TO DESCENDANTS OF WISTAR RATS AFTER TOTAL-BODY IRRADIATION ON NINTH DAY OF PREGNANCY. DEFORMATION OBSERVATION IN THE FIRST GENERATION. Gert Wegner and Klaus Kamminger (Universität, Marburg/Lahn, Ger.). Strahlentherapie, 121: 374-82(July 1962). (In German)

Forty-five 4-month-old Wistar rats were given a single whole-body x irradiation of 100 r at the 9th day of pregnancy. Ninety-two young animals of the first generation from 15 liters were examined after birth for deformities. Behavior as well as life expectancy of these animals were recorded. Deformities were accurately investigated histologically after spontaneous death. Thirty-seven cases (40%) of deformities of the brain and eye anlage were observed in 92 rats of the F_1-generation. The brain deformities were hydrocephalus internus of different degrees and advanced cases with dwarfism combined with eye deformities in 20% of the cases. Microphthalmia of different degree, some with residual visual function, in many cases, however, with an eye anlage not detectable visually and complete blindness was found in 33 rats of the F_1-generation. Complete microbulbus was detectable in these cases, too. The appearance of an advanced microphthalmus on one side and an eye with normal function and normal size on the other side is described. Manifest deformities or hereditary damages could not be observed in 65 rats of the second generation. The carcinogenic effect after whole-body irradiation of embryos is pointed out. (auth)

35570 COMPARISON OF INTERMITTENT AND CONTINUOUS UV IRRADIATION FOR PRIMARY ERYTHEMA FORMATION. Klaus Schmidt (Max-Planck-Institut für Biophysik, Frankfurt am Main). Strahlentherapie, 121: 383-91(July 1963). (In German)

Conclusions obtained in experiments with intermittent irradiation are discussed and two possible reaction-kinetic models for the direct pigmentation effect of long wave uv radiation are presented. The erythema-producing effect of intermittent uv irradiation on the human skin was determined and compared with the effect obtained by continuous radiation of the same total dose. Using pulse frequencies between 2 cps and 115 cps and a maximum irradiation dose of 1.4 mw/cm^2 there was no difference between the erythema effect of intermittent and continuous irradiation within the accuracy of measurement. (auth)

35571 THE EFFECTS OF UV IRRADIATION OR VITAMIN D_3 ON NORMAL AND RACHITOGENICALLY FED SPRAGUE-DAWLEY RATS. Ellen Seidl and Hilde Starlinger (Max-Planck-Institut für Arbeitsphysiologie, Dortmund, Ger.). Strahlentherapie, 121: 415-31(July 1963). (In German)

An investigation using 350 male Sprague-Dawley rats was carried out to determine whether there is a difference in the effect of the treatment with oral vitamin D_3 medication and irradiation with uv light or with the combination of both treatment methods in rachitic rats. The test was carried out using normal diet (Pellet) and using a phosphorus deficiency diet free of vitamin D_3. In addition to the weight development, Ca, P, and citric acid in serum and in bones, as well as the alkaline phosphatase of the serum and the ash content of the bones were determined. The initial weight of the animals was between 38 and 56 g. The experiment lasted 5 weeks. The same number of animals were killed and handled each week. The results of the experiment were represented as total averages as well as mean value to the first and second experiment period, respectively. A difference in effectiveness in vitamin D_3 and uv treatment could not be found. The results are discussed. (auth)

35572 ON THE ERYTHEMA- AND PIGMENT-EFFECTIVENESS OF VARIOUS UV RADIATORS. Ellen Seidl (Max-Planck-Institut für Arbeitsphysiologie, Dortmund, Ger.). Strahlentherapie, 121: 450-63(July 1963). (In German)

Erythema- and pigment-effectiveness of uv radiation using low intensity operation or pulse operation was compared with a HQL S 500 or a uv standard in about 200 persons 16 to 30 yr old. The test was made on the dorsal surface on both sides of the spine with a distance of 1 m and using a 40% irradiation stair. In case of pulse operation the threshold time for erythema was about 1.5 sec and increased 19 fold for low intensity operation, 23 fold for HQL, and 110 fold for the uv standard. The pigment effectiveness depends directly upon the degree of erythema obtained for all sources. The most lasting pigmentation was caused by administering 3 to 6 times the erythema threshold dose. Since the uv-flash light produces a more pronounced gradation of erythema than the other sources, it shows, therefore, a slightly higher pigment effectiveness. Single administration of a uv dose, producing an average degree of erythema, caused a distinct pigmentation lasting for several weeks. Pigmentation was almost completely inhibited if smaller radiation doses were administered initially. (auth)

35573 THE PATHOLOGY OF WHOLE BODY IRRADIATION. H. Teir (Univ. of Helsinki). Suomen Laakarilehti, 17: 321-8(1962). (In Finnish)

The lethal radiation dose varies with the size of the area of the body to which the radiation is directed. A single whole body dose of 200-600 r is, for example, lethal to man; whereas a local tumor may be treated with a total dose of 1000 r without occurrence of universal damage to the body. The author describes, in the first place, findings of postmortem examinations, compiled from literature and from corpses, of persons in which death was attributed to wholebody irradiation. Outward details of numerous investigations with laboratory animals were distinguished from data from postmortem examinations of men killed by atomic reactor disaster. When the radiation dose was over 900 r, mortality was 100%. Death followed shortly neurological symptoms, such as convulsions. In the case of the postmortem examinations, only lesser morphological changes such as primary shock were identified. When the dose amounted to 500-900 r, mortality was almost 100%. Death followed within 3 to 5 days after the irradiation with the appearance of gastrointestinal symptoms. From the postmortem examination intestinal necrosis and hemorrhaging were determined. With doses amounting to 100-500 r, the critical period appeared 8 to 10 days after irradiation. Hematological symptoms were foremost, and the patient died from hemorrhage (caused by increased capillary permeability due to thrombopenia) and secondary infection (from leukopenia, anemia had so decreased antibody formation). From the postmortem examinations, the presence of additional hemorrhage, necrotic pneumonia, and abscesses was established. (Atomdokumentation, 4 No. 15, Dec. 1962)

35574 MORPHOLOGICAL AND CYTOLOGICAL STUDY OF HUMAN AMNION CELLS IN THE COURSE OF RECOVERY FROM RADIATION INJURY. Masahiro Mizutani, Yuh H. Nakanishi, and C. M. Pomerat (Univ. of Texas, Galveston). Texas Rept. Biol. Med., 19: 811-24(1961).

Human amnion cells (Fernandes strain) cultured in vitro were irradiated with 1000-r doses of Co^{60} γ rays and examined by staining techniques for the next 5 days. The number of cells in the control cultures increased until a plateau was reached at 4 days, then began to decrease, perhaps due to an overgrowth of cells in the chambers. In contrast, irradiated cultures showed a progressive decrease in cell numbers during the 5-day period. During the first 3 days following irradiation, most cells became rounded, and finally disrupted. Mitotic index in nonirradiated cultures reached a max of 5.6% on the first day, then showed a gradual decrease. In the irradiated cultures, the mitotic activity of the cells was remarkably inhibited on the first day (0.8%), but it showed a sudden increase on the second day (9.1%), and reached max on the third day (15.7%). Then the mitotic index fell rapidly (2.3%), along with a decrease of cell population. The later higher values may result from the accumulation of the cells at metaphasic stage. Numbers of cells at prophase, anaphase, and telophase in irradiated cultures was much lower than that in nonirradiated controls through 5 days of observation. In most metaphasic figures the chromosomes showed abnormalities, such as fragmentation, stickiness, and clumping. These severe chromosomal aberrations might inhibit migration of chromosomes to the poles at anaphase, so that metaphasic cells underwent degeneration in this condition without advancing further. Control cultures showed a constant value of giant cells at 5 days (0.5–0.7%), while the incidence of giant cells on the second day was already higher in the irradiated cultures than in the controls. Then it increased markedly, due in part to a decrease in the total cell population, and reached a max (32%) on the third day after irradiation. The number of multinucleate cells, consisting of both giant and nongiant elements, significantly increased in irradiated cultures, as compared with control cultures. The rate of increase was linear from the second day (3.6%) to the fifth day (35.3%). On the fifth day following irradiation, ~70% of cells are giant elements. The modal value of chromosomes in the irradiated subline was maintained constantly at 73, in contrast to 75 in the parent line. This gradual shift in the modal value of chromosomes toward lower numbers with successive passages of cultures is suggestive of selective adaptation. (BBB)

35575 THE RADIOSENSITIZING ACTION OF CHLORPROMAZINE. G. Carraz (Ecole de Médecine et de Pharmacie, Grenoble). Therapie, 17: 19-21(Jan.-Feb. 1962).

A method for assaying the radioprotective or radiosensitizing effect of various drugs is described. Tumor cells are irradiated in the presence of the drug and changes in their oxygen consumption are subsequently measured in a Warburg apparatus. To carry out the procedure, ascitic fluid from mice bearing Ehrlich ascites sarcoma is centrifuged and the cells are resuspended in Krebs-Ringer solution so that 200 mg of cells are suspended in 1.25 ml. To this is added 1.25 ml of Krebs-Ringer solution containing the drug to be assayed. The cells are then irradiated for 10 min with 80-kv x rays at a rate of 100 r/min, giving a dose of 1000 r. Irradiation is carried out 1 hr after the cells are aspirated from the mice and their respiration is measured 1 hr after irradiation to determine the oxygen consumption for a 1-hr period. In 3 experiments, chlorpromazine at a concentration of 1.5% increased radiosensitivity by 12, 19, and 21%, with a mean of 17%. Another drug, 5601 RP (composition not stated), had only weak radiosensitizing activity (3%). (H.H.D.)

35576 EFFECTS OF GAMMA-IRRADIATION ON TULIP. I. EFFECTS OF BULB-IRRADIATION AFTER COMPLETION OF THE FLOWER BUD DIFFERENTIATION. Gisuke Meshitsuka, Hisao Matsubara, Masae Tabei, and Shozo Iba. Tokyo Metropolitan Isotope Centre Ann. Rept., 1: 86-96(1962). (In Japanese)

Tulip bulbs were irradiated by Co^{60} gamma-rays in November and January after completion of the flower bud differentiation. Dosages employed were 100–5000 r at dose rates of 70–80 and 700–800 r/hr. Plant growth was slightly accelerated at doses of 100 to 500 r, but was inhibited at higher dosages. Remarkable results were that red stripes and spots were observed in petals of White Rock, White Triumphator, and Field Marshal irradiated at lower doses, and higher doses more than 1000 r reduced petal width in almost all varieties. These effects appeared in high probability, almost 100%, and in good reproducibility. The effects of high dose irradiation appeared more strongly in the case of high dose rate. Pink areas of Y form in white petals were observed in X_2 induced from irradiated X_1 of Weber. (auth)

35577 CERTAIN DISTURBANCES IN METABOLIC PROCESSES RESULTING FROM THE EFFECT OF LOW TEMPERATURE AND IONIZING RADIATIONS. Yu. K. Ledentsov. Tr. 3-ei (Tret'ei) Vses. Konf., No. 3, 87-90 (1961).

By combining chilling with x irradiation of white rats (total dose 700 r), the rate of methionine-S^{35} inclusion falls to 41.1% in muscle protein, and to 81.1% in the liver, as compared with control values. Analogous results were ob-

tained for glycine-C^{14}. Maximum absorption of blood serum (280 mμ) as well as minimum (253 mμ) were unchanged; but the coefficient of absorption dropped significantly when chilling was combined with irradiation of animals, and less when the animals were irradiated only. Simultaneous paper chromatography showed that chilling combined with irradiation significantly raised the blood content of free amino acids, especially lysine (3 fold). Under the same conditions, cysteine in the urine and especially alanine rose; while the amount of lysine and of glutamic acid fell; but the concentration of the outer amino acids remained unchanged. These are the earliest symptoms of radiation injury and they are evident even during the first few days after irradiation. A link between the phenomena and the course of regenerative processes in animals is postulated. (Referativnyy zhurnal Biologicheskaya Khimiya, No. 8, 1963)

35578 EFFECTS OF CHRONIC GAMMA RADIATION IN RICE (ORYZA SATIVA L.). A. K. Basu. Trans. Bose Res. Inst. (Calcutta), 25: 49-52(1962).

Patnai, a pure-line winter variety of rice (Oryza sativa L.), was exposed to continuous or chronic gamma irradiation from a 20-C Co^{60} source in attempts to induce genetical changes. The plants, which were grown from germination to maturity in the gamma field, received four dose-rates of 54.4, 6.1, 2.2, and 1.1 r/day of gamma rays. The control was grown away from the source in a zone that received no radiation. In plant height, number of tillers per plant, and mean time of flowering there was not much variation. However, there was stimulation in the number of flowers per panicle in all the dose-rates. Seed fertility was impaired. The γ_2 had no variation except that one of the irradiated panicle progenies segregated for a chlorophyll mutant. The γ_2 panicles segregated for chlorophyll mutations like albino, xantha, and virescent in the γ_3 generation, which indicates that mutations were induced at a stage later than the separation of male and female organs of γ_1 flowers. The mutation rate increased with increasing dose-rates of gamma radiation. (auth)

35579 INDUCTION OF DOUBLE KERNEL IN ORYZA SATIVA LINN. BY IONIZING X-RAYS. Balaram Majumdar. Trans. Bose Res. Inst. (Calcutta), 25: 53-5(1962).

Dry seeds of variety Marichbati (Aus paddy) were treated with 75000 r x rays, and a single plant was isolated (S. 221) in the X_2 generation, having abnormal morphology of flower and seed. The selection was maintained for four successive generations and the behavior of abnormal flower and seed was studied. The abnormal characters breed true. The flowers of selection (S. 221) showed some addition and reduction in the number of anthers and ovaries. The number of kernel in each seed (= caryopsis) was usually two in the selection (S. 221) as against one in the control. The seeds of the selection (S. 221) were broader though narrower than the control (Marichbati). (auth)

35580 DIFFERENTIAL KILLING EFFECT IN JUTE BY X-RAYS AND RADIOISOTOPES. Rabindra Krishna Basu. Trans. Bose Res. Inst. (Calcutta), 25: 57-68(1962).

Treatments with x rays and β rays from P^{32} and S^{35} on dry and pure line seeds of three varieties of Corchorus olitorius L. and two varieties of C. capsularis L. produced differential killing effect. Over the range of dosages applied, treatments with P^{32} and S^{35} showed lesser killing effect than treatments with x rays. From the counts of survivals at maturity, the LD_{50} with x rays was found to lie between 64000 and 70000 r for the varieties of C. olitorius and between 80000 and 90000 r for the varieties of C. capsularis. While the usual relationship of decrease in survival with increase in dosage was established with x rays, treatments with P^{32} and S^{35} often showed increased survival compared to the control. The differential killing effect of the three mutagens is discussed as a consequence of difference in ion density. The obscure effects of radioisotopes may be due to production of substances reacting in the form of stimulation or protective agents. The differential radiosensitivity of the two species may be due to difference in factors like seed size and thickness of seed coat, which influence the non-genetical effects of irradiation. (auth)

35581 OFF-RESPONSE OF ELECTRORETINOGRAM INDUCED BY X-RAY STIMULATION. C. S. Bachofer and S. Esperance Wittry (Univ. of Notre Dame, Ind.). Vision Res., 3: 51-9(1963).

The ability of the grass frog Rana pipiens to produce an electroretinogram (ERG) in response to x rays, similar in some respects to the ERG produced in response to light, is reported. The on-response to x rays is comparable to the on-response to light. However, the off-response to x rays differs considerably from the off-response to light, and, moreover, differs in frogs of altered physiological condition (depending on the season, state of hibernation, and nutrition). Animals in prime physical condition show a very small off-response which involves a complex relation to the intensity and duration of the stimulus. Starved frogs show a very slow off-response, characterized by considerable amplitude and duration. All degrees of response were observed between these two extremes. It was concluded that physiological condition, related to inadequate nutrition, rather than the physiological changes associated with hibernation or reproduction, is responsible for the response observed. It is suggested that the human eye, similar in response in many respects to the frog eye or the eyes of other mammals, might produce off-responses to x rays similar to those described above for frogs, and, if so, they be related to a comparable physiological condition. (BBB)

35582 ON THE PROBLEM OF CARCINOGENESIS BY ROENTGEN AND GAMMA RAYS. G. Fuchs (Zentral-Röntgen-Institut des Kaiser-Franz-Josef-Spitals, Vienna). Wien. Med. Wochschr., 111: 145-8(Feb. 25, 1961).

Evidence implicating ionizing radiation in carcinogenesis is reviewed. The 1st case of radiation-induced cancer was reported in 1902; as early as 1911 94 such cases had been recorded. These early cancers were invariably found in skin inadvertently exposed to very high doses of x rays. Subsequently, many cases have been attributed to a single acute exposure. Various reported evidence relating malignancy to prior exposure to radiation is reviewed, including that relating to the increased incidence of leukemia in radiologists, thyroid tumor in children irradiated for thymus disorders, and cancer in the Hiroshima and Nagasaki survivors. (BBB)

35583 RADIATION HEMATOLOGIC AND COAGULATION STUDIES IN RATS AFTER WHOLE-BODY IRRADIATION WITH 1200 r. E. Szirmai. Z. Ges. Inn. Med. Ihre Grenzgebiete, 17: 359-60(Apr. 15, 1962). (In German)

Blood changes were followed for several days after irradiation of adult rats with 190-kv x rays at a rate of 42 r/min to a total dose of 1200 r. No changes in blood coagulation were noted the 1st two days postirradiation, but beginning on the 3rd day a prolongation of clotting time was noted. This was accompanied by a fall in the level of circulating free heparin, increase in prothrombin, factor V, and factor VII. Thrombin time and thrombin time determined with toluidine blue were decreased; the latter measures heparin-like antithrombin activity. The increase in prothrombin reached 150% after 72 hr and 210% after 80 hr. Elevations of factor V and factor VII were 170 and 140%,

respectively. These findings are discussed in terms of the release of kinases and activators of other types from injured irradiated tissue into the circulation which may also be promoted by the resulting tissue anoxia. (BBB)

35584 THE OSMOTIC RESISTANCE OF LEUKOCYTES AFTER ROENTGEN IRRADIATION. A. Santha (Military Hospital, Budapest). Z. Ges. Inn. Med. Ihre Grenzgebiete, 17: 436-41(May 15, 1962). (In German)

Surviving peripheral leukocytes from human, dog, and rabbit blood and from rat ascitic fluid were irradiated in vitro with 50 to 50,000 r doses of x rays, and osmotic resistance was tested by shaking with 0.30% saline solution. When whole blood was irradiated, doses of 1000 r and below did not appreciably affect resistance. However, above this dose a dose-dependent decline in resistance, after a short latent period, was noted. This fall in resistance was greater when the cells were irradiated in saline suspension, rather than in whole blood, and greatest when masses of washed unsuspended cells were irradiated. It was more marked when the cells were irradiated during suspension in previously irradiated plasma than in normal plasma, although irradiated plasma offered more protection to the leukocytes than saline. Since it has been proposed by Ludany that a plasma radioprotective factor arises from duodenal acidification, osmotic resistance of leukocytes was tested in the blood of dogs intraduodenally infused with 5 ml 0.1N hydrochloric acid. When the blood was drawn 25 min after this procedure was carried out, increased resistance of the leukocytes was demonstrable. (BBB)

35585 THE COLUMN CHROMATOGRAPHIC ANALYSIS OF 17-KETOSTEROIDS IN URINE DURING THE TREATMENT OF HORMONE-INDEPENDENT TUMORS WITH IONIZING RADIATION. Karl-Heinz Riessbeck (Universitats-Geschwulstklinik der Charite, Berlin). Z. Ges. Inn. Med. Ihre Grenzgebiete, 17: 657-65(Aug. 1, 1962). (In German)

Previous studies relating to changes in urinary excretion of 17-ketosteroids and 17-ketogenic steroids (corticosteroids) following radiotherapy are reviewed and references are cited. It is suggested that results of some of these previous studies are inconclusive since adequate differentiation was not made between steroids of hypophyseal-adrenocortical and gonadal origin nor was consideration made of their interrelations. In the present study urinary 17-ketosteroids were separated into 30 fractions by the column chromatographic procedures of Dingemanse, and Bauer. The results obtained with these fractions in the 352 irradiated patients were compared to those in 50 healthy controls, especially with regard to the following steroids: 11-hydroxycorticosteroids, androsterone, etiocholane, dehydroepiandrosterone, and epiandrosterone. The 30 fractions obtained by these chromatographic methods were considered as nine groups, each representing a mixture of steroids: Group I consisting of fractions 1-4, II and III of fractions 5-10, IV and V of fractions 11-16, VI of fractions 17-20, VII of fractions 21-4, VIII of fractions 25-7, and IX of fractions 28-30. Groups I-V are designated β-steroids, which are mainly of adrenal origin and from androgen metabolism, and 11-hydroxycorticosteroids which are catabolites of C-21 steroids, especially glucocorticoids. Groups VI and VII, designated α-steroids, in women consist almost entirely of 3α, 17-ketosteroids of adrenal origin and in men of testicular steroids. Group VIII consists mainly of 11-hydroxysteroids and Group IX of ketosteroids of unknown nature. (BBB)

35586 THE COLUMN CHROMATOGRAPHIC ANALYSIS OF 17-KETOSTEROIDS IN URINE DURING THE TREATMENT OF HORMONE-INDEPENDENT TUMORS WITH IONIZING RADIATION. Karl-Heinz Riessbeck (Universitäts-Geschwulstklinik der Charité, Berlin). Z. Ges. Inn. Med. Ihre Grenzgebiete, 17: 705-13(Aug. 15, 1962). (In German)

Previously described changes in the urinary steroid fractions at various intervals following Ra and x-ray treatment of various types of cancer are tabulated. In general, changes in these fractions reflected the state of central regulatory mechanisms, especially the pituitary-adrenal system, as influenced by irradiation and metabolic factors altered by the malignant state. Changes in the fractions could generally be correlated with changes in total urinary 17-ketosteroid levels. Changes in 11-hydroxycorticosteroids and dehydroepiandrosterone in particular could be traced to radiation-stimulated adrenocorticotropin activity. Ra treatment of uterine cervical cancer resulted in a marked decline in total 17-ketosteroid excretion, which was generally paralleled by reductions in steroids of Groups I-IX; however, initial elevations in Groups I-VI were sometimes recorded. More moderate reductions were noted in x-ray and γ-ray treatment of thoracic cancers, while irradiation of some peripheral tumors resulted in marked elevations in 17-ketosteroid excretion, especially in fractions corresponding to Groups IV-V. Changes in these fractions in individual cases are described in detail. (BBB)

35587 RADIOGENIC KERATOACANTHOSIS: CONTRIBUTION TO SO-CALLED PSEUDOREACTIVATION AFTER X IRRADIATION. H. J. Cramer (Hautklinik der Medizinischen Akademie, Erfurt, Ger.). Z. Haut-Geschlechtskrankh., 31: 122-7(Sept. 1, 1961). (In German)

The case history is cited of a 62-yr-old woman who developed acanthosis and skin malignancy apparently as a result of radiotherapy for a benign dermatologic condition. Two and a half yr before the malignant lesion was noted, an eczematous lesion in the gluteal region was irradiated with 450 r. Biopsy of the resulting 4 × 6 cm acanthotic lesion showed an infiltrating basal cell carcinoma on one border. Treatment of the tumor with 3900-r irradiation resulted in an ulcer which healed successfully, with apparent eradication of the malignant cells and without reactivation of acanthosis. From a review of similar cases in the literature, it is concluded that the term radiogenic keratoacanthosis is applicable to lesions resembling that observed here and resulting from radiation. (BBB)

35588 MODIFICATION OF THE GROWTH OF EHRLICH ASCITES TUMORS IN MICE BY NATURAL AND ULTRAVIOLET-IRRADIATED HETEROLOGOUS DESOXYRIBONUCLEIC ACID. Rudolf K. Zahn and Ekkehard Tiesler (Universität, Frankfurt am Main). Z. Naturforsch., 18b: 523-5(July 1963). (In German)

Desoxyribonuclease activity in the serum of Ehrlich ascites was determined by viscosimetry to be equivalent to $2.3 \pm 0.7 \times 10^{-6}$ g/ml of crystalline beef pancreas desoxyribonuclease. Injections of heterologous DNA into the Ehrlich ascites tumor under specified conditions does not alter tumor development. After uv irradiation, however, the DNA becomes strongly inhibitory for tumor growth. The possible implications are discussed. (auth)

35589 PLASTID MUTATION AFTER X IRRADIATION OF ARABIDOPSIS THALIANA. Gerhard Roebbelen (Universität, Gottingen, Ger.). Z. Vererbungslehre, 93: 25-34(1962). (In German)

The effect of x irradiation on individual variations in leaf color was studied in the Antwerp strain of this cruciferous plant. Various doses of 140-kv x radiation were applied to

the mature ova, pollen, and germinating seeds. Examination of the F_1 generation of plants showed that irradiation increased the rate of plastid-conditioned color changes in the leaves. The majority of F_1 plants undergoing mutation showed sectorially-arranged, chimeric white tissue in the leaves. Stems showing a random mixture of hereditarily different plastids were found in only 8.3% of F_1 generation plants. Variations in induced forms could be identified by cytologic detection of plastid mixed cells as plastome mutants. The frequency of such mutations was 0.195% after irradiation of seeds and 0.095% after irradiation of zygotes, compared with a spontaneous rate of 0.007%. These studies therefore demonstrate that it is possible to increase the mutation frequency of extrachromosomal structures by irradiation. (BBB)

35590 DIFFERENCES IN THE GENETIC RESULTS OF X IRRADIATION OF VARIOUS PLANT CELLS: STUDIES IN ARABIDOPSIS THALIANA. Gerhard Roebbelen (Universitat, Gottingen, Ger.). Z. Vererbungslehre, 93: 127-53 (1962). (In German)

Various parts of the curciferous plant A. thaliana (Antwerp strain) were x irradiated: flower buds, flowers, pollen, and seeds. The X_1 generation grown from the irradiated seeds corresponded to the plants raised from the irradiated archespore cells, pollen, egg cells or zygotes. By natural self-pollination of these X_1 individuals, the X_2 and the following generations were obtained. The radiation effects were markedly different in the 5 types of cells investigated. The radiation dose that gave 20% surviving plants (as percent of the seeds of ovules treated), was 28.6 kr for pollen, 21.9 kr for seeds, 5.4 kr for archespore cells, 5.1 kr for zygotes, and 2.5 kr for egg cells. Although these results might have been influenced by secondary selection mechanisms, some conclusions could be drawn regarding this varying sensitivity of the cells. In Arabidopsis it appears that diploid cells are more resistant than haploid, and that the compact nucleus of the pollen cell is more resistant than the more loosely structured nuclei of eggs or zygotes. In addition to this pattern of sensitivity, the cytogenetic effects of irradiating different types of cells suggest an influence of the nucleus status at the time of exposure. Thus nonhereditary malformations of rosette leaves in the X_1 generation of Arabidopsis appeared not only after irradiation of seeds but also after treatment of pollen. In the other three series, such X_1 deviations were lacking. Changes in the pollen nucleus must be one of the causes of the tissue degeneration. Likewise the fertility of the X_1 plants was diminished to differing degrees according to the kind of cell irradiated. A 20% dose applied to pollen and seeds induced a degree of sterility several times higher than that caused in egg cells and zygotes by corresponding doses. Of the total induced gene mutations in the X_2 generation, only those were recorded that could be recognized in the seedling stage. The frequency of these mutations arising from the same dose (8 kr) corresponds with the structure of the irradiated nucleus in the opposite direction from the sensitivity values reported above. Moreover the mutant spectrum was different, depending on the stage of the irradiated plants. Based on the relatively large number of progenies tested (17,360), it was concluded that even the frequency of single gene mutations was divergent for the five stages investigated. (TCO)

35591 EFFECT OF RADIATION ON ANTIMICROBIC IMMUNITY. R. V. Petrov. p.5-25 of "Immunologiya Ostrovo Luchevovo Porazheniya." Moscow, Gosatomizdat, 1962.

Observations carried out over a number of years established that ionizing radiation increases the sensitivity of the organism to pathogenic microbes and causative agents of infectious diseases. The sensitivity develops within three days following the exposure of the organism to radiation, and continues for periods of two to six weeks, depending on the dose of radiation administered and the type of the animal. The increase in the sensitivity of the animal organism to infection is claimed to be a definite proof of the harmful effect of radiation on immunity. (OTS)

35592 THE RELATIONSHIP BETWEEN RADIATION DOSE DELIVERED TO THE THYROIDS OF CHILDREN AND THE SUBSEQUENT DEVELOPMENT OF MALIGNANT TUMOURS. G. W. Dolphin and S. A. Beach (United Kingdom Atomic Energy Authority, Harwell, Berks, Eng.). 15p. (CONF-66-7)

From Symposium on the Biology of Radioiodine, Richland, Wash., June 1963.

The need in reactor siting for an investigation into the dose-response relationship for radioiodines is discussed. The quantitative dose-response relationship found from a study of surveys of children given x irradiation in early infancy was used to determine the dose-response relationship of radioiodine. No conclusion can be drawn about the probable form of the dose-response relationship but the tentative values assigned to the carcinogenic risk from radioiodine show that a child's thyroid is not specially radiosensitive. (auth)

35593 THE THERAPEUTIC USE OF RADIOACTIVE GOLD SEEDS IN NEOPLASMS. Paul Lachance and A. F. Vallee. 7p. (CONF-164-1)

From Society of Nuclear Medicine 10th Annual Meeting, Montreal, June 1963.

A method and the apparatus for the treatment of neoplasms with Au^{198} seeds are described. The introducer or gun is loaded with a magazine or cartridge containing 15 radioactive gold grains and then irradiated. The grains are cylinders made of gold encased in Pt with measurements of: length, 2.1 mm; diameter, 0.4 mm; weight, 25 mgm; platinum casing, 0.2 mm. The seeds are ready for use 7 to 10 days after irradiation or when gamma activity is around 3 to 4.5 mC per seed. A permanent implant gives to the tumor an approximate dose of 6000-7000 r in 4 to 5 days. The effectiveness and advantages of the method are also discussed. (P.C.H.)

35594 POSTOPERATIVE TREATMENT OF THYROID CANCER WITH RADIOACTIVE IODINE. William H. Blahd and Jerry M. Koplowitz (Veterans Administration Center, Los Angeles and Univ. of California, Los Angeles). 15p. (CONF-164-4)

From Society of Nuclear Medicine 10th Annual Meeting, Montreal, June 1963.

Experiences in the postoperative treatment of thyroid cancer with radioactive iodine since 1949 are reviewed. Forty-five patients received therapeutic amounts of I^{131} and were followed for more than one year. Cancer metastases were localized by means of the mechanical scintiscanner after patients had received large tracer doses of I^{131} preceded by injections of thyrotropic hormone. A consistent therapeutic regimen was followed involving four basic modalities of therapy: surgical thyroidectomy, thyrotropic hormone stimulation, cancerocidal doses of I^{131}, and thyroid extract administration. Twenty-nine patients in the series had proved metastatic lesions; 11 died, 18 are living, and 41% have lived 5 or more years. All patients who were free of metastases after initial thyroid surgery are alive. No complications from I^{131} therapy were

observed. This is attributed to the conservative dosage regimen employed. The results of the use of I^{131} in the postoperative treatment of thyroid cancer in other reported series are also reviewed. (P.C.H.)

Radiation Sickness

35595 (AD-287512) SYNTHESIS OF POTENTIAL ANTIRADIATION DRUGS. Annual Summary Report, October 1, 1961–September 30, 1962. Report No. 39. Leon Goodman and James E. Christensen (Stanford Research Inst., Menlo Park, Calif.). Nov. 1, 1962. Contract DA-49-193-MD-2068. 28p.

The trans-hexoside, methyl-2-amino-2,3-dideoxy-3-mercapto-D-altropyranoside hydrochloride was synthesized, employing the episulfonium ion approach and the two trans-pentosides, methyl 2-amino-2,3-dideoxy-3-mercapto-alpha-D-arabinofuranoside hydrochloride and methyl-3-amino-2,3-dideoxy-2-mercapto-α-D-xylofuranoside hydrochloride, were prepared by a similar method. The cis-pentoside, methyl-3-amino-2,3-dideoxy-2-mercapto-α-D-ribofuranoside hydrochloride, was synthesized by the complex neighboring group method that has been employed successfully in the hexose series. The pendant β-mercaptoethylamino sugars, methyl-3-(β-mercaptoethyl)-amino-3-dedxy-4,6-ethylidene-α-D-altropyranoside hydrochloride and methyl 3-β-mercaptoethyl)amino-3-deoxy-D-altropyranoside hydrochloride, were prepared as examples of uniquely substituted MEA molecules. Significant progress was made toward the synthesis of methyl 6-amino-6-deoxy-L-idothiapyranose hydrochloride and its free sugar which represent the ring structures that form from 6-amino-5,6-dideoxy-6-mercapto-L-idose derivatives. (auth)

35596 (AD-294344) PREPARATION OF RADIOPROTECTIVE AGENTS. Final Technical Report, September 1, 1959 to August 31, 1962. L. Citarel and N. A. Rosenthal (Thiokol Chemical Corp., Trenton). Contract DA49-193-MD-2053. 28p.

Bunte salts were synthesized in the hope that the radioprotective action of these compounds would be retained while reducing the toxicity level. It was found that some of the compounds did have fair to good radioprotective action, and in particular N-methylaminoethyl-thiosulfuric acid was found to be superior to the rest of the compounds evaluated. Their toxicity level was usually lower than the corresponding mercaptans. A method of screening compounds using polarographic techniques for the purpose of predicting their effectiveness as radioprotective agents was also developed. It was found that there was some correlation between the radioprotective action of the compounds and their oxidation-reduction potentials. Two approaches were attempted to incorporate radioprotective groups into a polymeric form. In both cases complications arose due to the extreme labile nature of the reactive groups. A third consideration arose from the desirability of maintaining a soluble polymeric material that would be amenable to infusion into the body. As a result various systems were tried to enhance the solubility of the polymer in aqueous solution while maintaining the appropriate radioprotective functional groups. Only a few polymers were able to complete these requirements and these at best could not be produced as originally conceived. Of the systems tried, three polymeric materials were submitted for evaluation. (auth)

35597 (LADC-5549) EFFECT OF DOSE RATE ON SURVIVAL TIME OF MICE DURING CONTINUOUS GAMMA-RAY EXPOSURE. T. T. Trujillo and J. F. Spalding (Los Alamos Scientific Lab., N. Mex.). Nov. 5, 1962. Contract [W-7405-eng-36]. 5p.

Young female mice (RF) were exposed continuously throughout life to Co^{60} γ rays at 10 different dose rates. Mean survival time (MST) and mean accumulated dose (MAD) were observed. The MST decreased in an exponential manner with increasing dose rate, while the MAD indicated that at the higher dose rates a large fraction of the accumulated dose is wasted or superfluous in causing radiation mortality. (auth)

35598 (NP-13055) GLYCIDIC ESTERS AND/OR ORGANIC DISULFIDES, AND RELATED SUBSTANCES, AS SOURCES OF ANTI-RADIATION DRUGS. Interim Research Report No. 15, April 1, 1963–June 30, 1963. J. D. Buckman, R. R. Crenshaw, A. Ferretti, H. K. Kim, W. B. Lacefield, and T. F. Parsons (Vanderbilt Univ., Nashville). Contract DA-49-193-MD-2030. 20p.

Procedures used in the preparation of organic disulfide compounds are reported. The compounds will be screened as possible anti-radiation drugs. (C.H.)

35599 (TID-17479) SURVIVAL OF MICE UNDER DURATION-OF-LIFE EXPOSURE TO GAMMA RAYS. I. DOSAGE-SURVIVAL RELATIONS AND THE LETHALITY FUNCTION. George A. Sacher and Douglas Grahn (Argonne National Lab., Ill.). Jan. 1962. Contract W-31-109-eng-38. 72p. (UAC-6830)

Results are reported from a study of the hematological and histological responses of mice to γ radiation and the lethal effects of daily exposure to various doses of γ radiation throughout life. An analysis is presented of the survival data in terms of the mean survival times and the main components of the variance. The quantitative relations between lethality and tissue injury are examined. (C.H.)

35600 (TID-19293) AN IMMUNOGENETIC STUDY OF THE MECHANISMS OF PROTECTION AGAINST RADIATION DEATH BY TREATMENT WITH HAEMOPOIETIC TISSUES. Research Report, December 1, 1962 to July 31, 1963. Gustavo Hoecker (Chile. Universidad, Santiago). Contract AT(30-1)-2488. 10p.

A method of in vivo culture without transplantation for the study of radiosensitivity of erythropoietically competent stem cells was developed. The results showed that the relation of red blood cell Fe^{59} to irradiation is exponential with a D_{37} of 81 r. The technique was used to study the effects of dose fractionation on recovery of erythropoiesis after irradiation. The results show that when the interval between the two doses is 5 hr, r.b.c. Fe^{59} is about 3 times that of mice receiving the same total dose in one exposure. Analysis of the survival of lethally irradiated coisogenic hosts protected with isogenic and allogenic B.M. infusions differing at H-2 showed a significant difference in mortality during the first two weeks. Cortisone was found to have a detrimental effect on the mice. (P.C.H.)

35601 (TID-19324) MATHEMATICAL MODELLING FOR THE MORTALITY EFFECTS OF VARIOUS RADIATION DOSAGE SCHEDULES. Report No. 2. A. S. Iberall (RAND Development Corp., Cleveland). Aug. 1963. Contract AT(11-1)-1254. 46p.

Data are presented on the lethal effects of various radiation dosage schedules in mice and rats. Mortality data are compared with life expectancy data. Emphasis is placed on the effects of dose rate on mortality rate. An attempt is made to represent lethality data on animals exposed to ionizing radiation dose by differential equations. (C.H.)

35602 (JPRS-20713) SHIFTS IN ADSORPTIVITY OF TISSUE IN ACUTE RADIATION SICKNESS. E. (Ye.) G. Dolgov. Translated from Arkh. Patol., 24: No. 3, 62-5 (Mar. 1963). 6p. (OTS-63-31570)

As the result of single generalized irradiation of white rats with a lethal dose of γ rays (800 r) the absorptivity of the tissues of the liver, kidneys, small intestine, spleen, lungs, and brain increases. Increased absorptive function of tissular elements occurs immediately (within 6 hr) after irradiation and by the third day it reaches its peak. These changes are the most marked in the tissues of the small intestine and spleen. The nature of the shift in adsorptivity reflects the dynamics of the alterational changes arising in the tissues under the effect of γ rays upon the organism. (auth)

35603 APPLICATION OF ANTIBIOTICS OF THE TETRACYCLINE ORDER IN EXPERIMENTAL RADIATION SICKNESS. A. M. Dumova and O. O. Chirkova (Scientific-Research Inst. of Antibiotics, Leningrad). Antibiotiki, 8: 723-8(Aug. 1963).

Experiments carried out on rats established that antibiotics of the tetracycline order, administered after the exposure of animals to radiation, prolonged the life of the animals. Further experiments established also that there was little quantitative difference between the aerobic flora isolated from the organs of irradiated animals treated with the antibiotics, and the flora isolated from irradiated rats not treated with antibiotics. This indicates that the beneficial effect of the antibiotics is due not only to the antimicrobic action of the drugs, but, apparently, to some other nonspecific protective forces of the organism, which are stimulated. (OTS)

35604 THE CLINICAL MANAGEMENT OF RADIATION EXPOSURE DUE TO ATOMIC EXPLOSIONS. Jack P. Clark (Goshen General Hospital, Ind.). GP, J. Am. Acad. Gen. Pract., 24: 124-9(Nov. 1961).

The recommended treatment for radiation exposure to atomic explosions is principally symptomatic and fundamentally based on the presenting picture. The therapeutic program should include: complete physical and mental rest with mild sedation, a bland, low-residue, high-protein diet, and general nursing measures, including skin care and oral hygiene to avoid ulcerations. Early shocklike syndromes with prostration, profound nausea, vomiting, and diarrhea indicate a very poor outcome, and these patients would present a problem of electrolyte and acid-base balance. The electrolyte problem could be hypochloremic alkalosis due to vomiting, hyperchloremic acidosis due to diarrhea, or possibly potassium depletion alkalosis due to inanition. Replacement therapy would attempt to maintain proper acid-base balance and a urinary output of 30 to 50 ml/hr. Use of an oral electrolyte solution, such as 4 oz of orange juice, 2 heaping tablespoons of sugar, one-half teaspoon of salt, and enough water to make a quart, would be helpful. Antinauseants would also be useful. If available, plasma, parenteral amino acids, albumin, and glucose would help maintain nutrition in the anorexic phase. Prophylactic antibiotics should be started about 5 to 7 days after exposure to treat infection via the radiation-damaged intestine. It is suggested that these consist of penicillin V, 250 mg, and tetracycline, 250 mg, orally every 6 hr. This would be continued throughout the period of significant granulocytopenia, and other antibiotics would be given via the parenteral route should infection develop. Anemia would be treated by transfusion only if it is severe. Maintaining hemoglobin at near normal levels may not increase patient-survival rates. Thrombocytopenia is a most important factor, and, for treatment of the hemorrhagic state, platelet transfusion may be used. No definite recommendations for using prophylactic compounds or dosages can be made at the present since their evaluation is not yet complete, and some of the compounds are toxic. Patients may be expected to show improvement in the hemogram about 30 days following exposure, and clinical improvement would be evident between 40 and 50 days. The majority of those suffering from radiation illness could return to work in about 3 months. (BBB)

35605 CHANGES IN PERIPHERAL BLOOD IN ACUTE RADIATION SICKNESS IN RATS PROTECTED WITH THE N-PHENYLAMIDINE THIOPHENE OF 2-CARBOXYLIC ACID. D. Zorgafov and I. Baev. Khirurgiya (Sofia), 14: 1109-12(1961). (In Bulgarian)

Treatment of rats irradiated with 600 r with this compound resulted in a greater decrease in but a quicker restoration of red cells and platelets. (BBB)

35606 TREATMENT OF THE INTESTINAL RADIATION REACTION. K. Neumeister and W. Schmidt (Medizinischen Akademie, Magdeburg, Ger.). Med. Klin. (Munich), No. 20, 842-4(1963). (In German)

The reactions occurring in the gastrointestinal tract after radiation treatment of abdominal tumors require careful treatment not only by the radiotherapists, but also by gynecologists, surgeons, and general practitioners. Nausea, meteorism, tenesmus, and blood and mucous discharge occur first in the illness. The possibility of modifying these symptoms was discussed. According to the results of specific investigations, the introduction of physiological intestinal flora is of great significance. (tr-auth)

35607 RADIATION INJURY REPARATION RATE LOSS AS A CHARACTERISTIC FEATURE OF ACUTE RADIATION SICKNESS IN REPEATED IRRADIATION. V. A. Rezontov. Med. Radiol., 8: No. 7, 52-6(July 1963). (In Russian)

Dogs (39) that survived whole-body Co^{60} gamma irradiation in a dose of 300 rads (LD−10/30) were subjected to a second dose of 300 rads at different periods ($1\frac{1}{2}$, $2\frac{1}{2}$, 5, and 15 months) after the first exposure. The phases of development of the postirradiation myelopoietic hypercompensation effect were assessed. In all the cases repeated radiation sickness ran a more severe course. The radiation sickness recovery rate was 2−3 times slower in comparison with the first radiation exposure. (auth)

35608 THE EXCRETION OF RADIOSODIUM IN RATS FOLLOWING TOTAL IRRADIATION. M. Rakovich and V. Gregora. Med. Radiol., 8: No. 7, 68-71(July 1963). (In Russian)

Regularities of radiosodium excretion from the animal's organism following whole-body irradiation in a dose of 1000, 600, and 200 r were determined. It was found that after total irradiation a considerable retardation of radiosodium discharge occurs in irradiation doses of 1000 and 600 r. This manifestation is not seen in irradiation with a dose of 200 r. Changes in radiosodium discharge are due to its markedly decelerated excretion with the urine. (auth)

35609 A CONTRIBUTION TO THE PROBLEM OF NORMALIZING THE HEALING OF FRACTURES IN THE CASE OF RADIATION DISEASE (AN EXPERIMENTAL INVESTIGATION). F. M. Golub and A. I. Britun. Med. Zh. Uzbekistana, No. 1, 11-14(1963).

The healing of bone-fractures was studied in 120 rabbits exposed to overall irradiation in a single dose of 400−600 r and in 20 controls. The second metatarsal

bone was cut through with scissors 1 day, 1, 3, 4, and 6 months after irradiation, and x-ray pictures of the fractures were taken 10, 15, 30, 45, 60, 75, and 90 days later. The animals were then killed, and the broken bones were studied histologically. While the fractures of the controls healed completely within 60–75 days, the bones of the irradiated rabbits showed fissures, false articulations, and failing restoration of the medullary canal after 90 to 120 days. Normal healing had been achieved previously in cases where the bone and the nerve were cut through simultaneously. An injection of 10–12 ml of an alcohol-novocaine solution (10% alcohol, 0.25% novocaine) into the soft tissue of the distal third of the femur blocked the afferent nerve fibers and thus stimulated the formation of callus considerably without causing morphological changes of the axons. The bones treated this way healed within 60–75 days. This result was obtained regardless of whether the solution was injected into the injured leg or into the contralateral extremity, and is attributed to a reflex mechanism in the latter case. The experiments indicated various ways of counteracting the harmful effect of irradiation on the regeneration of bones. (OTS)

35610 EFFECT OF MULTIPLE INJECTIONS OF CALCIUM COMPOUNDS ON THE SURVIVAL OF X-IRRADIATED RATS. R. H. Rixon and J. F. Whitfield (Atomic Energy of Canada, Ltd., Chalk River, Ont.). Nature, 199: 821-2(Aug. 24, 1963).

Multiple injections of Ca administered intraperitoneally to rats as the acetate, lactate, gluconate, produced a moderate increase in survival after exposure to a whole-body dose of 740 r x radiation. The effect of Ca was compared with effects previously observed with parathyroid extract and EDTA. The possibility is discussed that Ca may be involved in the protective action of these substances against radiation injury. (C.H.)

35611 THE APPLICATION OF THE ANTIKINETIC THERAPEUTIC AGENT MARZINE IN THE TREATMENT OF RADIATION SICKNESS. I. Kuzma and E. Siracka-Vesela (Oncological Research Inst., Bratislava). Neoplasma, 7: 404-7(1960).

Results are reported on the use of the antikinetic agent Marzine (1-diphenylmethyl-4-methylpiperazine) in the treatment of 47 patients, who developed radiation sickness in the course of the radiation treatment for malignant tumors. Marzine was effective in causing total disappearance of the symptoms in 62% of cases or a significant regression of symptoms in 31%. The influence of Marzine was usually noticed after oral application of three 50-mg tablets a day; only a few cases required six tablets a day. A two-day treatment sufficed in some cases for the total disappearance of the symptoms. Most cases, however, required treatment for 4 or 5 days, some even longer. During this time the symptoms disappeared or in some cases persisted in a milder form. After withdrawal of Marzine some patients developed symptoms of radiation sickness again and further Marzine treatment led to their disappearance. The patients did not develop habituation to Marzine and no side effects were noted. In only two cases Marzine failed, and in these the symptomatology was due to advanced carcinoma rather than irradiation. The most favorable effect was noticed in cases manifesting vomiting and nausea, followed by those with insomnia and vertigo. These were the most unpleasant attendant symptoms and often caused the irradiation schedule to be discontinued. The radiation treatment of patients administered Marzine did not have to be discontinued because of radiation sickness in any case. (BBB)

35612 CHEMICAL PROTECTION AGAINST THREE TYPES OF RADIATION DEATH, NAMELY HEMATOPOIETIC, GASTROINTESTINAL AND THE CENTRAL NERVOUS SYSTEM. Thomas J. Haley (Univ. of California, Los Angeles). Nucl. Hematol., 2: III-VII(Sept.-Nov., 1963).

Theories of radiation damage and protection are reviewed in order to analyze the mechanisms for radioprotection of animals. The sequence of events in three types of radiation death — hematopoietic, gastrointestinal, and central-nervous-system (CNS) — are outlined. It is shown that some chemicals can provide protection against the first two of these types of death, but that CNS death cannot be ameliorated with any known radioprotective drugs. (T.F.H.)

35613 DIETARY NUTRITION AND RADIATION INJURY. I. EFFECT OF DIETARY PROTEINS ON SURVIVAL OF MICE EXPOSED TO TOTAL-BODY γ-IRRADIATION. Seiei Tanaka, Atsushi Nukazawa, Yoshimasa Yoneyama, and Haruhisa Yoshikawa. Tokyo Metropolitan Isotope Centre Ann. Rept., 1: 97-103(1962). (In Japanese)

The nutritional effects of dietary proteins on mice exposed to whole-body γ irradiation were observed. Young male mice were fed a standard protein diet and one deficient in protein for two or three weeks. The survival rates of mice exposed to a single sublethal dose of whole-body γ irradiation (1000 r) were observed. The deficiency in protein before irradiation lowered the survival rate of mice, but this effect could be overcome in some degree by the supplement of adequate protein immediately after irradiation. The excessive addition of protein however showed an unfavorable influence. The supplemental effects of some essential amino acids such as threonine and methionine were also examined. (auth)

35614 DESOXYRIBONUCLEIC ACID SYNTHESIZING PERIPHERAL BLOOD CELLS STUDIED BY IN VITRO UPTAKE OF ^{3}H-THYMIDINE. REPORT 2. STUDIES OF DNA SYNTHESIZING CELLS IN PERIPHERAL BLOOD IN VARIOUS PEDIATRIC PATIENTS. Yoshiaki Misawa (Yokohama Univ., Japan). Yokohama Med. Bull., 12: 23-30(Feb. 1961). (In English)

DNA-synthesizing cells in the peripheral blood of various pediatric patients were studied by 1-hr incubation in vitro with tritiated thymidine and stripping film autoradiography methods. An increased number of labeled mononuclear cells of different morphological types were found in the blood of pediatric patients with viral infections, diarrheal disorders, state of recovery from upper respiratory infections, acute hemolytic anemia, and leukemia. (P.C.H.)

35615 THE EFFECTIVENESS OF DIFFERENT FREEZE STORAGE TECHNIQUES FOR MOUSE BONE MARROW CELL SUSPENSIONS. L. M. Van Putten (Association EURATOM T.N.O.). 11p. (CONF-29-2; EUR 242.e)

From Conference on Modification of Radiation Injury by Bone Marrow Transplantation and Chemical Protection, New York, Dec. 1962.

The effectiveness of different freeze-storage techniques for mouse bone marrow cell suspensions was quantitatively investigated. As the criterion for effective storage, the ability of the suspensions to protect lethally irradiated mice was estimated. The fresh suspensions as well as the suspensions that had been frozen and thawed by different methods were tested in serial twofold dilutions in irradiated mice to estimate the 50% effective cell dose for 30-day survival. Variables investigated were: ACD versus

Tyrode's solution as a diluent; comparative effectiveness of glycerol and dimethyl sulfoxyde to protect during freezing; and three different methods of handling the suspensions after thawing. The percentage recovery of protecting ability of the suspensions after storage varied with different techniques between 72% and less than 10%. Best results were obtained when glycerol-protected cells were slowly diluted with Tyrode's solution before injection. Application of the techniques to the storage of rhesus monkey bone marrow suspensions indicated that there are marked interspecies differences in storage efficiency for a given technique. (auth)

CHEMISTRY

General and Miscellaneous

Refer also to abstract 35263.

35616 (HW-SA-2804) DISTRIBUTION COEFFICIENTS FOR CERTAIN ACTINIDE AND FISSION PRODUCT CHLORIDES IN THE IMMISCIBLE MOLTEN SALT SYSTEM: $LiCl-K^+AlCl_4^-$. R. H. Moore (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Mar. 26, 1963. Contract AT(45-1)-1350. 24p. (CONF-14-33)

From American Chemical Society 144th National Meeting, Los Angeles, Mar. 1963.

It is shown that Al_2Cl_6 reacts with chloride ion in two steps to form $Al_2Cl_7^-$ and $AlCl_4^-$. The effects of $AlCl_3$/KCl mole ratio on the distribution of U between $KCl-AlCl_3$ and molten Al are plotted, and the reactions of UCl_3 with Al are discussed. The $LiCl-KCl-AlCl_3$ system is next investigated, and its immiscibility gap was studied as a function of temperature. KCl was found to be a better Cl^- donor for complexing of $AlCl_3$ than LiCl, and in turn CsCl is a better donor than KCl. It is suggested that the immiscibility gap in the $LiCl-KCl-AlCl_3$ system is mainly due to the formation of complex poly-ions in the Li-rich phase. Distribution coefficients in the immiscible pair $LiCl-KAlCl_4$ were measured at 625°C for the following solutes: UO_2Cl_2, $UCl_4(+SnCl_2)$, UCl_3, $PuCl_4(+Cl_2)$, $PuCl_3$, $CeCl_3(+Cl_2)$, $CeCl_3(+SnCl_2)$, $FeCl_3(+UCl_3)$, $FeCl_3$, $RuCl_3$, $SnCl_2$, $SrCl_2$, NaCl, and CsCl. The possible applications of the data to separations are considered briefly. (D.L.C.)

35617 (NYO-10329) THE ADAPTATION OF NEW RESEARCH TECHNIQUES TO MINERAL ENGINEERING PROBLEMS. Semi-Annual Progress Report for the Six-Month Period Ending May 30, 1963. (Massachusetts Inst. of Tech., Cambridge. Dept. of Metallurgy). Contract AT(30-1)-956. 50p. (MITS-50)

Thermal conductivity detector calibration for adsorbate vapors, water, and n-butyl amine was reduced to simple linear functions by least squares analysis. An improved adsorption cell was constructed, and the isotherms for water vapor and n-butyl amine adsorption on ferric oxide at 25 and 35°C were obtained. Surface areas were determined from the water adsorption isotherms. Adsorption isotherms of hexadecyl sulfonate on hematite were obtained from the aqueous phase (ketone saturated) at pH 4.5, 5.5, and 7. Adsorption of potential determining ions (H^+ and OH^-) at different ionic strengths was measured, and the value of the zero point of charge was estimated from suspension effect measurements. The distribution coefficient of sulfonate between ketone and water was determined over a wider range of pH values. Interfacial tension between ketone and water as a function of sulfonate concentration was measured at pH 4.5 and 5.5. Contact angles between ketone-water-hematite were measured as a function of sulfonate concentration at the previous pH values. The distribution of dodecylammonium chloride (DAC) between dodecane and water in a dodecane-quartz-H_2O-DAC system was measured over a range of pH and DAC concentration. Also the adsorption isotherms for DAC on quartz from aqueous and dodecane phases were obtained, and the interfacial tension of the water-dodecane interface was determined as a function of pH and DAC concentration. Hysteresis of contact angles in a nitrogen potassium ethyl xanthate (KEX)-galena system was measured by the bubble method for four KEX concentrations. The advancing angle was 90°; and the receding angle was 54°, resulting in a hysteresis of 36°. Research on the thickening mechanism showed that exclusion of air from a cylinder containing clay in water resulted in the formation of compact pellet-like flocs upon shaking the cylinder. The effects of fuel component ratios, flow rates, and pressures on the intensity of lines in a flame spectrophotometer was studied, and spectrograms for several elements over the range 3000 to 6500 Å were obtained. Research in particle size determination by combined centrifugation and gamma-emission dealt with maintaining temperature constancy and a high signal-to-background ratio of gamma emission by the sample suspension. (D.C.W.)

35618 (ORNL-TM-545) CHEMICAL TECHNOLOGY DIVISION, QUARTERLY PROGRESS REPORT FOR CHEMICAL DEVELOPMENT SECTION B, OCTOBER-DECEMBER 1962. R. E. Blanco (Oak Ridge National Lab., Tenn.). Sept. 4, 1963. Contract W-7405-eng-26. 82p.

Progress is reported on developments in the hydrolysis of carbon-uranium systems, processing of breeder reactor fuels, protactinium absorption studies, corrosion studies, disposal of high- and low-level wastes, fission product recovery by ion exchange methods, foam separation mechanisms in waste processing, thermodynamics of solvent extraction processes, and chemical applications of nuclear explosions. (B.O.G.)

35619 (ORNL-TM-669) THE FEASIBILITY OF DIRECT GAS-PHASE CONVERSION OF UF_6 TO UC. R. G. Wymer and O. C. Dean (Oak Ridge National Lab., Tenn.). Sept. 6, 1963. Contract [W-7405-eng-26]. 9p.

It is shown thermodynamically that the gas phase reaction of UF_6 with CH_4 and H_2 to form UC solid is approximately 80% complete at 2000°K and 0.01 atmosphere equilibrium pressure. UC formation is shown to be strongly favored by decreased pressure and increased temperature. Thirteen pertinent reactions and their equilibrium constants as a function of temperature are tabulated. (auth)

35620 (TID-3564(Rev.1)) MOLTEN SALTS: SELECTED REFERENCES. William E. Bost, comp. (Division of Technical Information Extension, AEC). Mar. 1963. 34p.

A bibliography of 415 references is presented. Most of the references are to unclassified reports, although journal, book, and patent references are included. Author and report availability indexes are included. (D.L.C.)

35621 (TID-17798) ADSORPTION STUDIES ON CLAY MINERALS. VIII. ION EXCHANGE PROPERTIES OF NATURAL AND THERMALLY ALTERED MONTMORILLONITE. Andrew W. Loven and Henry C. Thomas (North Carolina. Univ., Chapel Hill). [nd]. Contract AT(40-1)-2130. 25p.

The ion-exchange behavior of a thermally collapsed montmorillonite clay is compared with that of the natural mineral. Equilibrium measurements in the cesium-barium system at different temperatures demonstrate that the markedly increased selectivity for cesium shown by the altered clay is due to changes in the enthalpy of the exchange process, probably partially compensated by a specific entropy effect favoring the sorption of barium. (auth)

35622 (TID-19359) ANALYTICAL CHEMISTRY AT LOW CONCENTRATIONS. Annual Report No. 7. John T.

Stock (Connecticut. Univ., Storrs). July 31, 1963. Contract AT(30-1)-1977. 28p.

The conditions for the amperometric titration of low concentrations of nitrite with sulfamic acid or with cerium(IV) were worked out. Considerable data were obtained on the solubilities of mercuric chloride and lithium chloride by ethylenediamine-water systems. Some of the properties of the mercury — saturated mercuric chloride and lithium chloride in ethylenediamine — reference electrode were investigated. Studies of the synthesis, polarography, and uses in amperometric titration of certain 2,8-disubstituted quinoline compounds were continued. Exploration work on photometric titrations in nonaqueous solvents other than acetic acid, the amperometric titration of low concentrations of ferric iron with mercurous compounds, and on biamperometric titrations at amalgam electrodes, is reported. (auth)

35623 IMPROVEMENTS IN OR RELATING TO POLYMERIC COMPOSITIONS. Gaetano Francis D'Alelio. British Patent 934,455. Aug. 21, 1963. Filed June 15, 1961.

A process for the preparation of a thermoplastic polymeric composition with fire-retardant properties is patented. A chloro-polyfluoro compound and a polymer or copolymer of one or more polymerizable alkenyl aryl compounds are irradiated by an energy source of at least 100 kev. This causes Cl atoms and/or polyfluoro-alkyl groups derived from the chloro-polyfluoro compound to be introduced into the polymer or copolymer. The chloro-polyfluoro compound may be a liquid and serve as a solvent for the polymer or copolymer. Specific compositions for the chloro-polyfluoro compound and the polymer or copolymer are described. (M.P.G.)

35624 IMPROVEMENTS IN OR RELATING TO ACTINIDE METAL OXIDE SOLS. Thomas Lee O'Connor, Walter Juda, Paul Henry McNally, and Norman Wolfson Rosenberg (to Diamond Alkali Co.). British Patent 934,813. Aug. 21, 1963. Priority date Nov. 12, 1958, United States.

A method for the production of aqueous hydrated actinide-metal-oxide sols is patented. A solution of the actinide-metal compound is added to an agitated slurry of anion exchange resin containing preformed actinide oxide sol as seed nuclei. The process is continued until the seed particles are at least 1000 times their original weight. The slurry of ion exchange resin is at boiling temperature. Acid is added to the final actinide oxide sol to adjust the pH of the sol to between 2.5 and 6.5. The method is especially suitable for the production of ThO_2 sols. (M.P.G.)

Analytical Procedures

35625 (AD-294406) DEVELOPMENT OF ANALYTICAL TECHNIQUES FOR THE DETERMINATION OF MINUTE QUANTITIES OF SELECTED ELEMENTS IN BERYLLIUM. Interim Report No. 3, October 6, 1962 through December 6, 1962. W. M. Henry (Battelle Memorial Inst., Columbus, Ohio). Jan. 11, 1963. Contract NOw 62-0629-c. 6p.

Experimental work on beryllium directed primarily toward method development and evaluation in the following analytical areas is described: emission and mass spectrography, carbon analysis, activation analysis for oxygen determination, and resistivity measurements. (auth)

35626 (AERE-AM-3) THE DETERMINATION OF RADIOSTRONTIUM. G. J. Hunter and M. Perkins (United Kingdom Atomic Energy Authority. Research Group. Chemistry Div., Woolwich Outstation, England). Apr. 1963. 22p.

The separation of radiostrontium with inactive strontium carrier involves their combined precipitation with barium as the nitrates in fuming nitric acid, scavenging with ferric hydroxide, and removal of the barium by precipitating the chromate. After precipitating the strontium as carbonate and removing any remaining barium with a further chromate precipitation, any occluded chromium is reduced and subsequently removed by a second ferric hydroxide scavenge. Finally, strontium carbonate is precipitated, which is then counted. The method is applicable to solutions of fission products in nitric or hydrochloric acids, and is written with particular reference to the determination of Sr^{89} and Sr^{90}. The procedure is especially suitable when a determination of radiobarium is also required. The coefficient of variation should not exceed 5% when counting statistics permit. (auth)

35627 (AFSWC-TDR-62-146) A STUDY OF TECHNIQUES FOR REACTOR EFFLUENT ANALYSIS. Final Report. Rodney Melgard (Tracerlab., Inc., Richmond, Calif.). Dec. 1962. Contract AF29(601)-2852. 70p. (AD-295426)

Methods for quantitative analyses of effluent samples from direct-cycle, air-cooled nuclear reactors are presented. Methods were developed for analyses of beryllium and uranium in 10^{9} gram levels in various collection media, and the level of beryllium and uranium present in the unexposed media was determined. Separation and decontamination schemes were developed for the detection of the following radionuclides: Mo^{99}, Sr^{89}, Sr^{90}, Ru^{103}, Ru^{106}, Cs^{136}, Cs^{137}, Ba^{140}, Y^{91}, Cd^{115}, and Np^{239}. Collection media investigated included several filter papers, canisters of activated carbon, and gummed paper. (auth)

35628 (IS-612) SPECTROPHOTOMETRIC DETERMINATION OF SCANDIUM WITH ARSENAZO. Hiroshi Onishi and Charles V. Banks (Ames Lab., Ames, Iowa). [Feb. 12, 1963]. Contract [W-7405-eng-82]. 23p.

Arsenazo is used for the spectrophotometric determination of scandium in the range 10 to 50 μg. The absorbance is measured at 570 mμ and pH 6.1. A method is proposed for the successive determination of scandium and thorium. Scandium is separated from magnesium, calcium, rare earths, zirconium, fluoride, phosphate, and some other metals by extraction with TTA in xylene. Copper, aluminum, and iron(III) are removed by 8-quinolinol-chloroform extraction. Uranium(VI) is removed by anion exchange using hydrochloric acid. Thorium is separated from scandium by anion exchange using nitric acid. (auth)

35629 (LA-2921) SPECTROPHOTOMETRIC DETERMINATION OF MICRO QUANTITIES OF CHLORIDE IN PLUTONIUM METAL. Karl S. Bergstresser (Los Alamos Scientific Lab., N. Mex.). May 1963. Contract W-7405-eng-36. 12p.

Micro quantities of chloride are determined spectrophotometrically after separation from plutonium metal by pyrohydrolysis. Complete separations are accomplished by heating samples of plutonium metal at 900 to 1000°C in a stream of argon initially saturated with water at 85°C. The gas stream sweeps the trace element, as hydrogen chloride, into an alkaline absorbing solution. Reagents are added to form colored ferric thiocyanate complex in an amount equivalent to the chloride, and concentration of the complex is determined spectrophotometrically as an indirect measurement of chloride. Optimum range of chloride concentration in analyzing 1-gram plutonium sam-

ples by this method is 10 to 50 ppm, with relative standard deviations of 12 and 8 percent, respectively. The range can be extended to 5 and 200 ppm by modifying sample size. Iodide, bromide, cyanide, and thiocyanate interfere in this spectrophotometric chloride method, but these ions normally are not present after a pyrohydrolytic separation. (auth)

35630 (NBL-195) SEMIANNUAL PROGRESS REPORT [ON CHEMISTRY] FOR THE PERIOD JULY 1962 THROUGH DECEMBER 1962. (New Brunswick Lab., AEC, N. J.). Aug. 1963. 58p.

The separation of impurities from Pu solutions by cation exchange prior to spectrographic analysis was investigated. The effects of mannitol on the determination of boron in Pu and U using cation exchange and emission spectrography were studied. The spectrographic determination of impurities in Pu following anion exchange separation from Pu in 8N HNO_3 was applied to Cs_2PuCl_6 and PuO_2-UO_2-C. The effects of different acid concentrations on the sensitivity of the spectrographic method was studied. The constant-current potentiometric titration of Pu with primary standard $K_2Cr_2O_7$ was modified for use with larger samples. The study of Cs_2PuCl_6 for use as an analytical Pu standard is continued. Pu was separated from U solutions by crystallization as $Pu(SO_4)_2 \cdot 4H_2O$. A cation exchange separation method for trace impurities is given which permits spectrochemical analysis of the separated impurities. A rapid x-ray fluorescence method is described for the determination of small quantities of Zr in a uranyl nitrate matrix. The use of uranium ion beams from a thermionic emission ion source for mass spectrometric ratio measurements of weight percent U^{235} was investigated. The conversion of mass spectrometer vacuum systems to ion pumps is described. An automatic liquid level controller was devised for use with liquid nitrogen. (D.L.C.)

35631 (PG-Report-436) ANALYTICAL METHOD FOR THE ABSORPTIOMETRIC DETERMINATION OF URANIUM (PYRIDYL-AZO-NAPHTHOL METHOD) FOLLOWING SEPARATION BY REVERSED-PHASE CHROMATOGRAPHY. (United Kingdom Atomic Energy Authority. Production Group, Springfields, Lancs, England). 1963. 9p.

Uranium is separated from excess of other metal ions by reverse-phase partition chromatography. The uranium is ultimately precipitated as the complex with pyridyl-azonaphthol in water-acetone medium at pH 9 and isolated by filtration. The precipitate is dissolved in hydrochloric acid and after dilution the absorbance of the solution is measured at 440 mμ. It is applicable to impure solutions containing 20 to 180 μg uranium in the portion taken for the determination. The range may be extended by suitable aliquoting or change in the length of the light path. There is no bias over the stated range. Nineteen determinations on impure solutions, in the range 65 to 75 μg uranium, gave a precision of ±2 μg at the 95% confidence level. (auth)

35632 (PG-Report-443) ANALYTICAL METHOD FOR THE ASSAY OF TRIBUTYL PHOSPHATE. (United Kingdom Atomic Energy Authority. Production Group, Springfields, Lancs, England). 1963. 5p.

Tributyl phosphate was oxidized with a sulfuric-nitric acid mixture. The nitric acid was removed by evaporation and the phosphate precipitated as the quinoline phosphomolybdate complex. The complex was filtered, dried at 230 to 250°C, and weighed. The method is considered to be free from bias. At the 99.25% tributyl phosphate level, the precision (3 × sigma) is ±0.17%. (auth)

35633 (PG-Report-474) ANALYTICAL METHOD FOR THE VOLUMETRIC DETERMINATION OF TOTAL ALKALINITY IN AMMONIA LIQUORS EXPRESSED AS PERCENTAGE HN_3. (United Kingdom Atomic Energy Authority. Production Group, Springfields, Lancs, England). 1963. 5p.

A known quantity of the ammonia solution is added to a measured volume of standard acid solution and the excess acid is titrated with standard sodium hydroxide solution. The method is applicable to commercial and analytical grades of ammonia solution. The method is considered to be free from bias, and at the 30% w/v level the standard deviation is ±0.1%. (auth)

35634 (TID-19094) RAPID RADIOCHEMICAL SEPARATION AND ACTIVATION ANALYSIS OF RARE EARTH ELEMENTS. K. Rengan and W. Wayne Meinke (Michigan. Univ., Ann Arbor. Dept. of Chemistry). [1962]. Contract [AT(11-1)-1143]. 22p. (CONF-14-28)

From American Chemical Society 144th National Meeting, Los Angeles, Mar. 1963.

Rapid separation of different rare earth elements was effected in ten to sixteen minutes with a small cation exchange resin column and α-hydroxy-isobutyric acid as eluent. Individual rare earth fractions could be obtained with controlled eluent concentrations and pH. Good separation with peak to valley ratio between 50 and 100 in the elution curves was accomplished in about ten minutes for rare earth elements with atomic numbers differing by three or more. Less complete but useable separations of adjacent rare earths such as gadolinium and terbium could be made in about sixteen minutes. This rapid separation procedure was coupled with gamma spectrometry for determination of rare earths in samples such as monazite and the U. S. Geological Survey samples G-1 and W-1 by activation analysis. The applicability of this method for the entire group was investigated by separating rare earth elements ranging from praseodymium to ytterbium. (auth)

35635 (TID-19361) APPARATUS FOR SIMULTANEOUS DIFFERENTIAL THERMAL ANALYSIS AND THERMOGRAVIMETRIC ANALYSIS TO 1500°C. Karl S. Vorres (Purdue Univ., Lafayette, Ind.). [nd]. Contract [AT(11-1)-1246]. 12p.

An apparatus for carrying out both differential thermal analysis and thermogravimetric analysis in different gases at pressures up to one atmosphere and temperatures up to 1500°C is described. Advantages of this design are enumerated. (auth)

35636 THE USE OF ORGANIC SOLVENTS AS ELUENTS IN CATION-EXCHANGE SEPARATIONS. IV. POSSIBILITY OF SEPARATING ZIRCONIUM AND HAFNIUM. S. Ionescu, Sabau Grigorescu, and St. Spiridon. Acad. Rep. Populare Romine, Studii Cercetari Fiz., 12: 269-77(1961).

Zirconium-95 ($3.8\ 10^{-3}$ g/ml) and Hf^{181} ($7.03\ to\ 10^{-4}$ g/ml) were used for investigating the separation of the two metals over KU_2 cationite from acid solutions (pH 3) using mixtures of organic solvents and inorganic acids. The separation was studied as a function of the thickness and ionic form of the cationite layer, nature of the organic solvent, and its concentration and that of the acid in the eluent. It was found that Zr and Hf separate readily in a column ≥2.3 cm long, 0.8 cm in diameter, filled with KU_2 in the H form using ~100 ml concentrated HCl–acetone–water (3 : 4 : 3) as an eluent at a rate of 3 drops per min. A gamma spectrometer was used to check separation. Other forms of cationite (Na_1^+, K^+, Ba^{2+}) assist in separating the peaks, but the quantity of eluent used is considerably greater. When

acetone is replaced by other solvents (isopropyl alcohol, methylethyl ketone, diethyl ketone, and acetyl acetone; the last two mixed with HCl in a ratio of 7 : 3) the peaks become more distinct, the quantity of eluent is greatly reduced, but the elution beds become covered. (Referativnyy zhurnal Khimiya, No. 20, 1962)

35637 DETERMINATIONS OF URANIUM AND THORIUM IN MINERALS AND SOLUTIONS BY X-RAY SPECTROGRAPHY. B. G. de Wappner. Anales Asoc. Quim. Arg., 50: 97-110(1962).

The analysis of minerals and aqueous solutions by x-ray spectrography is briefly described. Mineral samples may be either fused with $Na_2B_4O_7$, or powdered and pelleted, alone or with nitrocellulose. For the determination of U and Th, the x-ray source employed was a tube with a tungsten anode giving maximum intensity from 0.39 to 0.51 Å at 40 kv, in combination with a NaCl crystal goniometer and a Geiger-Mueller x-ray detector tube. The calibration curves were linear. The method has the advantages of being nondestructive and requiring only small samples (from 10 to 100 mg). (Atomdokumentation, 5: No. 13, July 1963)

35638 AUTOMATIC COUNTING OF RADIOACTIVITY ON TWO-DIMENSIONAL PAPER CHROMATOGRAMS. V. Moses (Univ. of California, Berkeley). Atomlight, No. 31, 9-11(Sept. 1963).

A technique was developed for automatic counting of radioactivity on two-dimensional paper chromatograms. Radioautography by placing the developed chromatogram in contact with high-speed x-ray film enables the compounds to be located. Once the exact position of the several compounds is known they may be cut out from the complete chromatogram and counted separately. The excised chromatogram spots are mounted on a support of Mylar polyester film to form a strip bearing spots only at certain specified intervals. Two gas-flow end-window detector tubes are used for counting. (M.C.G.)

35639 THE SEPARATION OF BISMUTH FROM URANIUM BY EXTRACTION AND PRECIPITATION WITH 1-PHENYL-TETRAZOLE-5-THIOL. D. B. Stevančević. Bull. Boris Kidrich Inst. Nucl. Sci., 14: 67-72(Apr. 1963). (In English)

1-Phenyl-tetrazole-5-thiol was used for the gravimetric determination of Bi in the presence of U and other elements that may occur as components of the U-Bi alloys (Pb, Zr, Fe, Mg, Al). The precipitation was performed from an acetate medium with a neutralized 0.1 M solution of 1-phenyl-tetrazole-5-thiol. Only Cu, Ag, and Hg were seen to interfere. In samples where U is the basic component, it is possible to separate Bi by extraction with the chloroform solution of the reagent, from the same acetate medium from which only Cu, Ag, and Hg are extracted together with Bi. (P.C.H.)

35640 REVIEW OF ANALYTICAL METHODS FOR DETERMINATION OF RARE EARTHS. [PART] II. Teresa Nowicka-Jankowska and Zofia Radwan (Inst. of Nuclear Research, Polish Academy of Sciences, Warsaw). Chem. Anal. (Warsaw), 8: 307-25(1963). (In Polish)

Spectrophotometric methods for determination of rare earths include direct methods utilizing absorption spectra of tripositive ions of rare earths and indirect methods using colored complexes of rare earths are reviewed. The development, problems, and uses of these methods are discussed. Methods for determination of radioactive rare earths in fission products and reactor materials are listed. Neutron activation methods and their uses are described. Tracer techniques in rare-earth analysis are also discussed. One hundred and ninety-four references are included. (M.C.G.)

35641 FLUOROMETRIC DETERMINATION OF TRACE QUANTITIES OF BERYLLIUM IN SILICATE MINERALS WITH MORIN. PART II. THE SEPARATION OF BERYLLIUM AND THE RESULTS OF THE DETERMINATION. Władysław Rutkowski (Inst. of Nuclear Research, Polish Academy of Sciences, Warsaw). Chem. Anal. (Warsaw), 8: 389-94(1963). (In Polish)

A method for the determination of trace quantities of beryllium in silicate minerals and aqueous solutions using the fluorescent properties of its complex with morin was worked out. The sample was decomposed initially with a mixture of hydrochloric and sulfuric acids. From the obtained solution, in the presence of thioglycolic acid, the hydroxides were precipitated and fused with sodium hydroxide. The melt was digested with water, the masking reagents were added, and pH of the solution was adjusted to 11.5. After an addition of morin the fluorescence intensity in respect to fluorescein standard (2.5 μg/ml) was measured using a spectrophotometer. The concentration of beryllium was determined from the calibration curve. The results of the determination of beryllium up to 0.80 μg Be/ml of the final solution in minerals and aqueous solutions are given. The results of the determination of the contents of beryllium up to 10 ppm in minerals are reproducible within ±6%, for pure solutions of beryllium, within ±3.2%. The advantages and disadvantages of the method were discussed. (auth)

35642 THE COMPARATIVE INVESTIGATION OF METHODS OF THE DETERMINATION OF SULFUR IN ORGANIC PRODUCTS USING ABSORPTION OF X AND GAMMA RADIATIONS. Ludwik Górski and Jerzy Grabczak (Academy of Mining and Metallurgy, Krakow). Chem. Anal. (Warsaw), 8: 415-24(1963). (In Polish)

The possibilities of application of isotopic sources of gamma and x radiations for the determination of sulfur in hydrocarbons are discussed. The analytical methods are based on the absorption of radiation utilizing a difference between the absorption coefficients of hydrocarbon and sulfur for the energy about 20 kev. The properties of a Sn^{113} source which has a radiation energy of 25.8 kev were presented. This source is inexpensive and has a useful shape of metallic foil, but the physical properties do not allow for its versatile use. Fe^{55}, T^3, Pm^{147}, Cd^{109}, Sn^{113}, and x-ray tube are discussed as sources. Sensitivity, precision, detectable limit, the dependence on the composition of hydrocarbon and half time of decay were taken into account. It appears that the detectable limit of sulfur is (0.05 ± 0.025)% S obtained with Fe^{55} as a radiation source. The optimum range of the method is from 0.3 to several per cent of sulfur. In practice the most useful isotopic sources of radiation are: T^3, for constant composition of hydrocarbon, and Pm^{147}, for strongly varying composition. The advantages of the isotopic sources resulting from a simplicity of application and from the possibilities of application to continuous analysis are discussed. (auth)

35643 APPLICATION OF HIGH-RESOLUTION MASS SPECTROMETRY IN ORGANIC CHEMISTRY. R. D. Craig, B. N. Green, and J. D. Waldron (Associated Electrical Industries Ltd., Manchester, Eng.). Chimia (Aarau), 17: 33-42(Feb. 15, 1963). (In English)

The principles, techniques, instrumentation, and applications of high-resolution mass spectrometry are reviewed

and illustrated by examples of studies on organic compounds. A description is also given of a double focusing mass spectrometer (MS 9) that has been specifically designed for these techniques. The new instrument has a resolving power in excess of 10,000 and an accuracy of mass measurement better than 1 part in 10^5. This high resolution technique combined with accurate mass measurement enables more precise information to be obtained on the atomic composition of ions in the mass spectrum of an organic compound than has previously been possible with the more usual single focusing mass spectrometers. Compared with conventional single-focusing mass spectrometers the main difference in the MS 9 is the addition of an electrostatic analyzer to obtain higher resolution. Other additional features, such as a wide range of sample introduction facilities, not generally found on single-focusing instruments, are also included in its design. Compared with the MS 8, the new instrument uses a resolving system of twice the previous dimensions, the provision of an electron multiplier detector, and faster scanning, a more versatile and accessible ion source, and improved facilities for rapid and accurate mass measurement. There are two completely independent final collector systems, both of which are provided with variable slits: a principal collector incorporating a high sensitivity electron multiplier for high resolving power work with very narrow slits or for fast scanning with a wide collector slit; and an auxiliary collector system for routine work at low resolving power. A further new feature is the differential pumping provided between the source and analyzer regions. The only connection between the two regions is the narrow source slit, ensuring that the sample pressure in the analyzers is at least 10,000 times less than that in the source. In this way, contamination of critical surfaces in the analyzers by organic compounds is avoided. Application of MS 9 to determination of molecular wt and atomic composition, structural analysis, and quantitative analysis is illustrated. (BBB)

35644 NON-DESTRUCTIVE DETERMINATION OF THE ENRICHMENT OF U-235 IN A FUEL PLATE BY GAMMA-RAY SPECTRA. J. P. Chien and H. H. Hsu (National Tsing Hua Univ., Sin-chu, Taiwan, China). Chinese J. Phys. (Taiwan), 1: 14-16(Apr. 1963).

A direct comparison method for determining the U-235 content in the fuel elements of the Tsing-Hwa reactor is described. (auth)

35645 ARSENATE METHOD OF IODOMETRIC DETERMINATION OF ZIRCONIUM. G. B. Shakhtakhtinskii and A. S. Sarkisyan. Dokl. Akad. Nauk Azerb. SSR, 18: No. 10, 31-4(1962). (In Russian)

Experimental techniques for quantitative precipitation, filtration, elution, and solution of prepared zirconium arsenate precipitate in a strong acid are discussed. Precipitation of zirconium arsenate was carried out at the boiling point in a solution with 10% free sulfuric acid and using sodium arsenate as precipitating agent (with 40 : 1 ratio to zirconium). Elutions using hot 2% ammonium chloride solutions produced better results than elutions with hot or cold water. Ten to twelve elutions proved to be sufficient. Without boiling, zirconium precipitates as $Zr(HAsO_4)$; following 1 hour of boiling it transforms into a more stable $ZrAs_2O_7$. Results of Zr precipitation in hydrochloric and nitric acid media were in good agreement. (R.V.J.)

35646 ON THE ISOTOPIC COMPOSITION OF BORON IN NATURE. Yu. P. Shergina and A. B. Kaminskaya (All-Union Research Inst. of Geology, Leningrad). Geokhimiya, No. 8, 725-31(Aug. 1963). (In Russian)

Methods of the isotopic analysis of boron were worked out in order to allow the isolation of boron as borax from rocks with a 5.10^{-4}% content of boron (without isotopic separation in the process of chemical preparation) and to analyze its isotopic composition by the method of thermionic emission on borax ions with a reproducibility of 0.2%. A study of boron isotope distribution in nature was started; considerable variations of the boron isotopic composition that reach 2.5% and are conditioned by processes of secondary rock alterations were found. (auth)

35647 RADIOCHEMICAL ANALYSIS BY THERMAL NEUTRON ACTIVATION. DIRECT DETERMINATION OF VANADIUM IN 18/8 STEEL BY MEASUREMENT OF THE ACTIVITY OF VANADIUM-52 (PERIOD OF 3.76 MINUTES). W. Haerdi, Ed. Martin, and D. Monnier (Université, Geneva). Helv. Chim. Acta, 46: 1572-80(1963). (In French)

The values (832 and 814 ppm) obtained by direct determination of V in activated 18/8 steel are much higher than those determined by x fluorescent spectroscopy (730 ppm). The method proposed has the advantage of being rapid, simple, and sensitive. It is possible, under proper conditions of activation and measurement, to make direct determinations on 0.1 to 0.05 mg of steel, the determination limit being 0.05 μg of V. (tr-auth)

35648 DETERMINATION OF THE URANIUM CONTENT OF WATER WITH SODIUM DIETHYLDITHIOCARBAMATE. E. Upor. Hidro. Kozl., 39: 76-7(1959).

To determine the concentration of uranium, the organic matter in a sample of water is destroyed by treatment with potassium permanganate and boiling until the color no longer disappears. After addition of aluminum sulfate and thorium chloride, ammonia is used to precipitate ammonium uranate with the aluminum and thorium hydroxide. The precipitate is leached with hot soda solution, the solution is weakly acidified with hydrochloric acid, carbon dioxide is boiled off, the pH value is adjusted to about 6 with ammonia, iron is masked with EDTA, and the uranium oxide-diethyldithiocarbamate complex is produced. The complex is shaken with chloroform and the color depth of the solution is determined photometrically. The method is applicable only to concentrations of more than 0.1 mg of uranium per litre. (TCO)

35649 DETERMINATION OF FREE ACID IN URANYL NITRATE SOLUTIONS BY ANION EXCHANGE. V. G. Korgaonkar (Atomic Energy Establishment, Trombay, India). Indian J. Chem., 1: 195-8(May 1963).

A simple and accurate method, which can be employed for routine work in the laboratory, was worked out for the estimation of free acid in uranyl nitrate solutions. Uranium is complexed with Na sulfate and separated by adsorption on an anion exchange resin column in sulfate form. The free acid, which is also adsorbed as bisulfate, is selectively eluted with a dilute solution of Na sulfate, and titrated with standard alkali. About 0.3 mmole of HNO_3 can be accurately estimated in the presence of up to 1.3 mmoles of U. Alkali and alkaline earth metals and Mg do not interfere in the determination whereas Fe, Al, Th, Ti, Zr, and rare earth elements do interfere. The method compares well in accuracy with the ferrocyanide and peroxide methods. (auth)

35650 CHEMISTRY OF CERIUM(III). PART I. AN ELECTROMETRIC STUDY ON THE QUANTITATIVE PRECIPITATION OF CERIUM(III) AS NORMAL SELENITE. Sarju Prasad and Suresh Kumar (Banaras Hindu Univ.,

Varanasi, India). J. Indian Chem. Soc., 40: 445-50(June 1963).

The results of a series of conductometric titrations of cerium(III) against seleneous acid with an overall concentration of 70% ethanol are reported. The possibility of carrying out direct as well as reverse titrations over a wide concentration range of cerium(III) was established and the effect of ethanol concentration was also studied. Under the cited conditions the study lends support to the formation of cerous normal selenite [molar ratio of Ce(III) : Se being 2 : 3]. (auth)

35651 RADIOACTIVE SODIUM IODIDE (NaI^{131}) SOLUTION. EXAMINATION OF PURITY—NOTE. J. Pijck (Université, Ghent). J. Pharm. Belg., 17: 218-19(July-Aug. 1962).

The control of the chemical and radiochemical purity of NaI^{131}, according to the American and British Pharmacopeias, involves chromatographic analyses. After addition of I^- and IO_3^- as carrier ions, the sample is subjected to ascending paper chromatography using 75% methanol. The Belgian Pharmacopeia calls for a similar assay. However, according to the U. S. Pharmacopeia the I^- and IO_3^- bands are demonstrated solely radiochemically. It stipulates that the activity of the IO_3^- band should not exceed 5% that of the I^- band and that other bands are not present. The British Pharmacopeia relies upon the separation of the 2 ions which are then converted to iodine. The developed chromatographic strip is cut in half lengthwise, and the strips are treated to form I, which is determined by its color. A modification of this technique is described whereby the reactants are vaporized on the paper, and the color of I is intensified by starch. Another modification is described for detection of the I^- band, consisting of the oxidation of I^- by a 3% solution of H_2O_2 or KNO_2. The IO_3^- formed reacts with the I^- present from the reaction cited above. These reactants are vaporized on the band and the color is determined with starch. Radiochemical assay of the bands using a collimated scintillation detector and continuously recording apparatus is also described, which readily permits determination of activity and Rf values of the bands. (BBB)

35652 DETERMINATION OF ALKALIES IN URANIUM. V. T. Athavale and C. V. Krishnan (Atomic Energy Establishment, Bombay). J. Sci. Ind. Res. (India), 21B: 339-40 (1962).

The flame spectrophotometric method has been previously used for the determination of alkali metals in uranium solutions, but this requires special types of fume hoods over the flame to prevent contamination of laboratory atmosphere with uranium. Therefore an ion-exchange method for separation of alkali metals from uranium prior to their flame spectrophotometric determination was devised. Sodium, potassium, and lithium were separated by an ion-exchange method using a carboxylic type resin (Merck IV). An ion-exchange column was prepared with 100-200 mesh resin in a 1.2 × 23 cm glass tube. The 15-cm column of resin was equilibrated with N ammonium chloride and used to separate uranium from a uranyl nitrate solution containing the other cations. The sample of uranyl nitrate was evaporated to dryness on a water bath to remove as much free acid as possible. It was then taken up in 10 ml N ammonium chloride; the solution was passed through the column which was then washed with 75 ml N ammonium chloride solution at a flow rate of 1 ml/min. The effluent and washings were collected, evaporated to dryness, and heated carefully to decompose the ammonium salts. The remaining alkali metals were determined flame photometrically using an oxyhydrogen flame. (BBB)

35653 CONTRIBUTION TO THE DETERMINATION OF ZIRCONIUM IN STEEL. A. J. Leeb and F. Hecht. Radex Rundschau, No. 1, 360-5(1963). (In German)

A method for the quantitative chemical analysis of 0.01 to 2% Zr in Ti-free steel based on the separation of Zr from other elements by precipitation with cupferron, fusion with Na_2CO_3, and precipitation with NH_4OH is described. The separated Zr in sulfuric acid solution is determined photometrically using pyrocatechol-purple as indicator. (Rev. Metal Lit., 20: No. 7, July 1963)

35654 THE SEPARATION AND DETERMINATION OF MICROGRAM AMOUNTS OF SCANDIUM AND THORIUM. Che-ming Nee and Shu-chuan Liang (Inst. of Chemistry, Peking). Sci. Sinica (Peking), 12: 1238-9(Aug. 1963). (In English)

Th is separated from Sc in acidic (pH = 3.2 to 3.4) aqueous solutions by extraction using 5,7-dichloro-8-quinolinol in chloroform. The organic layer, containing the Th, is mixed with Xylenol Orange in ethanolic solution, and the optical absorbancy is measured in order to determine the Th content. Sc is then separated from the original aqueous solution by increasing the acidity to pH 5 to 5.5, and again extracting with 5,7-dichloro-8-quinolinol in chloroform. At this pH range, the Sc is taken into the organic layer. The Sc is then determined by the same method as that used for the Th. The method is applicable to Sc contents of 3 to 15 μg and Th contents of 10 to 100 μg. (T.F.H.)

35655 THE EXTRACTION OF MICROGRAM AMOUNTS OF ZIRCONIUM WITH N-BENZOYL-N-PHENYLHYDROXYLAMINE. Che-ming Nee, Chung-fun Chu, and Shu-chuan Liang (Inst. of Chemistry, Peking). Sci. Sinica (Peking), 12: 1239(Aug. 1963). (In English)

The separation of Zr from acidic aqueous solutions by extraction using N-benzoyl-N-phenylhydroxylamine is studied. It is found that this method is applicable for Zr contents of 5 to 100 μg. The separated Zr is determined by optical absorptiometry using Xylenol Orange. (T.F.H.)

35656 USE OF OXYCELLULOSE FOR COLLECTION OF TRACES OF METALS. I. QUALITATIVE INVESTIGATIONS. E. Schulek, Zs. Remport-Horváth, and A. Lásztity (L. Eötvös Univ., Budapest). Talanta, 10: 821-6(Aug. 1963). (In English)

As a substance containing carboxyl groups, oxycellulose is used for the collection and detection of metal ions in very high dilutions (0.001 to 0.1 ppm). From 3 to 5 mg of oxycellulose is applied for 100 or 1000 ml of solution. Also, the method proves to be suitable for the collection and detection of mixtures of various ions. The dependence of the collection of the following ions on pH was investigated: Ag^+, Al^{3+}, Ba^{2+}, Bi^{3+}, Cd^{2+}, Co^{2+}, Cr^{3+}, Cu^{2+}, Fe^{2+}, Fe^{3+}, Hg^{2+}, Mn^{2+}, Ni^{2+}, Pb^{2+}, Sr^{2+}, UO_2^{2+}, VO^{2+}, and Zn^{2+}. (auth)

35657 DETERMINATION OF SMALL AMOUNTS OF ZIRCONIUM. II. ANALYSIS OF REFRACTORY SAMPLES. Mohammed Rafiq, Charles L. Rulfs, and Philip J. Elving (Univ. of Michigan, Ann Arbor). Talanta, 10: 827-32(Aug. 1963). (In English)

In connection with the determination of small amounts of zirconium in complex samples, procedures were developed for bringing various types of sample into solution and removing possible interferences. These procedures allow p-bromomandelic acid to be ised as a precipitant for the final recovery of zirconium for gravimetric measurement. The applicability of these procedures, which are described in detail, was investigated by the analysis for zirconium of a variety of refractory mineral and metallurgical samples. (auth)

35658 APPLICATIONS OF CONTROLLED-POTENTIAL COULOMETRY TO THE DETERMINATION OF PLUTONIUM. A REVIEW. W. D. Shults (Oak Ridge National Lab., Tenn.). Talanta, 10: 833-49(Aug. 1963). (In English)

The determination of plutonium by controlled-potential coulometric titration was studied and used at Oak Ridge National Laboratory over a period of several years. Two methods, the primary (direct) and secondary (indirect) titrations, were applied to the analysis of a wide variety of materials. They were used for the determination of total plutonium, or ionic and polymeric plutonium contents, and of the oxidation state distribution of plutonium solutions. The techniques, procedures, and separations that were developed are described. The effects of some contaminants that are common to plutonium-containing samples are also presented. (auth)

35659 CONTRIBUTIONS TO THE BASIC PROBLEMS OF COMPLEXOMETRY. XII. SUCCESSIVE DETERMINATION OF THORIUM, RARE EARTHS AND SOME OTHER ELEMENTS. Rudolf Přibil and Vladimír Veselý (Polarographic Inst., Czechoslovak Academy of Sciences, Prague). Talanta, 10: 899-903(Aug. 1963). (In English)

The successive determination of thorium and rare earths with diethylenetriaminepentaacetic acid (DTPA) and triethylenetetraminehexaacetic acid (TTHA) is described. Such a determination cannot be carried out with the commonly used EDTA or diaminocyclohexanetetraacetic acid (DCTA). By combined titrations with DTPA and TTHA it is possible to determine successively not only thorium and rare earths, but also some bivalent elements which might be present in the material to be analyzed. (auth)

35660 A NEW PRINCIPLE OF ACTIVATION-ANALYSIS SEPARATIONS. IV. SUBSTOICHIOMETRIC DETERMINATION OF TRACES OF SILVER. Jaromir Růžička, Jiří Starý, and Adolf Zeman (Charles Univ., Prague). Talanta, 10: 905-9(Aug. 1963). (In English)

A substoichiometric determination of traces of silver in germanium dioxide and in metallic lead was developed. It consists of simultaneous irradiation of a standard and test sample in a nuclear reactor followed by dissolution and addition of silver carrier. After adjusting the pH, the samples are extracted with the same substoichiometric amount of dithizone in carbon tetrachloride and the activities of the organic extracts measured. This single-step separation procedure is fully satisfactory because of its high selectivity. Moreover, substoichiometry avoids the necessity of determining the chemical yield. The procedure developed could be adapted without difficulty for the determination of traces of silver in other materials. (auth)

35661 INTERNATIONAL COMPARISON OF ANALYTICAL METHODS FOR NUCLEAR MATERIALS. I. ACCURACY AND PRECISION OF SOME TECHNIQUES IN ROUTINE TRACE ANALYSIS. G. B. Cook, M. B. A. Crespi, and J. Minczewski (International Atomic Energy Agency, Seibersdorf, Austria). Talanta, 10: 917-29(Aug. 1963). (In English)

The results of an international comparison designed to show the accuracy and precision of some techniques of trace analysis used routinely are given. The techniques are emission spectrography, absorption spectrophotometry, polarography, and neutron activation. A common sample, an aqueous solution containing approximately 5 ppm of copper and manganese and 15 ppm of chromium and mercury was analyzed by 9 different laboratories. The statistical analysis of the results (551 in all) shows, with the limitations as to generality imposed by the design of the experiment, that the expected precisions of a single determination in the routine application of each of the techniques are: spectrography, ±40%; polarography, ±25%; activation, ±20%; and spectrophotometry, ±10% at the 0.05-probability level. The accuracy follows the same pattern though the spread of results within a technique is wider. When all results are considered together the precision is ±25%. (auth)

35662 COPRECIPITATION OF MICROGRAM AMOUNTS OF BERYLLIUM AND THORIUM WITH ORGANIC REAGENTS. K. Sudhalatha (Atomic Energy Establishment, Trombay, India). Talanta, 10: 934-6(Aug. 1963). (In English)

Methods for coprecipitating microgram amounts of beryllium and thorium using organic coprecipitants are reported. The former is coprecipitated with methylene blue and tannic acid at pH 8 to 10, while the latter is coprecipitated with methyl violet and SPAONS at pH 8. (auth)

35663 ACTIVATION ANALYSIS OF METALS AND THEIR ALLOYS. Masatoshi Kobayashi and Teruko Sawai. Tokyo Metropolitan Isotope Centre Ann. Rept., 1: 25-32 (1962). (In French)

The analysis of impurities in aluminum was done by the neutron activation method. After the irradiation of samples the activities of each element contained in the sample were compared with those of the standards by using a γ-ray spectrometer. If necessary, the chemical separation of some elements was done before the measurement of their activities. Each impurity in aluminum refined by the zone melting has a different behavior. By using this method the distribution of copper and manganese elements was determined in a bar of aluminum refined by zone-melting. The activation analysis of oxygen in metals was studied by neutron activation of the mixture of lithium fluoride and the powdered metallic sample. The content of oxygen in metals can be determined from the activity of F^{18} produced from the following nuclear reactions: $Li^6 + {}^1n \rightarrow He^4 + H^3$ and $H^3 + O^{16} \rightarrow {}^1n + F^{18}$. Irradiation for 1 hour at the thermal neutron flux of 7×10^{11} n/cm^2 sec brought about the activity of F^{18} to 20-200 cpm/mgO_2, the limit of detection was about 10 ppm. A bit of carbon content in steel was determined by the measurement of the activity of N^{13} produced by the nuclear reaction $C^{12}(p,\gamma)N^{13}$. (P.C.H.)

35664 X-RAY SPECTRO-CHEMICAL ANALYSIS OF LEAD CONTENTS IN CRAYONS. Syuji Yamashita. Tokyo Metropolitan Isotope Centre Ann. Rept., 1: 45-52(1962). (In Japanese)

Investigations were made on the lead component in crayons, pastel crayons, and water colors, made in Japan, by x-ray spectro-chemical analysis. The results showed that some of the crayons contain considerable amounts of lead. Moreover, the effects of the lead component on chromaticity were also studied. It is shown that the chromaticity does not depend on the amount of lead component contained. (P.C.H.)

35665 SPECTROPHOTOMETRIC STUDIES OF THORIUM REACTION WITH DATISCETIN. I. P. Alimarin, A. P. Golovina, and Yu. M. Kezhutin. Vestn. Mosk. Univ., Ser. II, Khim., No. 3, 66-9(May-June 1963). (In Russian)

Spectrophotometric studies were made of thorium reaction with newly prepared datiscetin dye (3,5,7,2′-tetraoxyflavone). In presence of alcohol or acetone the reaction produced an orange-colored easily soluble solution. Absorption curves were developed for thorium datiscetinate water-alcohol solution with various concentrations of hydrogen ions and using 1×10^{-2} and 1×10^{-3} m/l solution of datiscetin in ethyl alcohol and 1.71 g/ion Th/l thorium perchlorate. Photometric method was developed for determining thorium in monazite sands. (R.V.J.)

35666 PHOTOCOLORIMETRIC DETERMINATION OF Ce IN CARBON STEEL BY MEANS OF O-TOLYDINE. E. A. Nechaeva and T. M. Kholodkova (Dnepropetrovsk Metallurgical Plant, USSR). Zavodsk. Lab., 29: 803-4 (1963). (In Russian)

A method of photocolorimetric determination of 0.01 to 0.10% Ce in carbon steel is described. The order of error is 0.002%. (R.V.J.)

35667 EQUIPMENT FOR ACTIVATION ANALYSIS OF OCEAN BOTTOM CORES (Engineering Materials). (Dresser Research. Div. of Dresser Industries, Inc., Tulsa, Okla.). 46 units. (CAPE-1010)

An apparatus used in neutron activation analyses of ocean-bottom core samples using neutrons from the T(d,n)α reaction is described. Cores are analyzed for their content of Si, Al, Mg, Na, and Fe by neutron activation methods, and their content of K, U, and Th by the spectrum of their natural radioactivity. The equipment consists of a small, modified, portable neutron generator; a 3 × 3 in. NaI(Tl) scintillation detector mounted in a lead shield 3 in. thick; and a multichannel analyzer, in combination with a spectrum integrator-stripper and a control unit. An IBM computer typewriter and an X-Y plotter are used for readout. A neutron shield surrounds the neutron source tube with 5 in. of lead and 5 in. of a mixture of wax and boric acid (30% by weight). The shield accommodates a horizontal port for long cores, a vertical port for short cores, and an opening for a "Pilot B" plastic scintillator used as a neutron monitor. (F.E.S.)

35668 TANDEM MAGNETIC ANALYZER MASS SPECTROMETER SYSTEMS. E. J. Michael and D. J. Marshall (Pennsylvania State Coll., University Park). 12p. (CONF-74-16)

From 11th Annual Conference on Mass Spectrometry and Allied Topics, San Francisco, May 1963.

Tandem mass spectrometer systems with twelve-inch-radius, ninety-degree-sector magnetic analyzers were built for the precise analysis of low-abundance isotopes of uranium and plutonium. A triple filament ion source is used. Ions are detected either by a standard electrometer system or by an electron multiplier. System pressures of 1×10^{-9} torr are achieved in the analyzer region. The instruments have provision for collection of all or part of the ion beam at the intermediate focus. The abundance sensitivity of the "S" tandem is compared to that achieved in the first stage of the instrument. (auth)

Inorganic and Physical Chemistry

35669 (AD-295124) THE EFFECT OF SUBSTITUTION ON THE IONIZATION POTENTIALS OF FREE RADICALS AND MOLECULES. V. EXTENSION OF THE DENSITY MATRIX TREATMENT TO A TWO-BODY MODEL FOR ELECTRONS OUTSIDE A "CORE." Technical Report No. 9. Joyce J. Kaufman (Martin-Marietta Corp. Aerospace Div., Baltimore). Dec. 1962. Contract Nonr-3471(00). 8p.

Extension was made to a two-body model for a pair of electrons outside a "core" for the treatment by density matrix formulism of a one-body model for an electron outside a "core." Differences in ionization potentials between the parent compounds for the π electron of alkyl radicals can be developed exactly as a one-body model problem in terms of density matrices. The derivation of the two-body model permits the same effects on the ionization potentials of an electron from the lone pair of substituted amines to be described by an analogous treatment using the same perturbation Hamiltonian as for substituted alkyl radicals with two electron functions for the lone pair of the nitrogen. (auth)

35670 (AERE-M-1257) NOTE ON ELECTROPLATING ^{63}Ni. G. T. Rogers and D. E. Glanville (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England and United Kingdom Atomic Energy Authority. Research Group. Wantage Research Lab., Wantage, Berks, England). July 1963. 5p.

Two methods are described which were used to deposit high-specific-activity nickel at low cost. In the first method, suitable for specific activities of 5 to 40 mc per g, the Ni content is reduced by a factor of about 8 compared with the Watts formula, to about 7.5 g per liter. In the second method, used for specific activity of 120 mc per g, the volume of electrolyte is reduced to a few drops. (auth)

35671 (AERE-R-3788) FURTHER OBSERVATIONS OF THE NEAR INFRA RED EMISSION SPECTRA OF URANIUM AND PLUTONIUM. E. W. T. Richards, N. J. Atherton, and E. B. M. Steers (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). July 1963. 39p.

Following further work on emission spectra in the 0.8 to 2.5 micron region, observations of isotope shifts in uranium are reported, including data for U^{236}, U^{235}, and U^{233}. Isotope shifts in plutonium, and additional lines, are also reported. The simultaneous isotopic analysis of uranium and plutonium is discussed, and shown to be feasible, but a detailed method is not yet available. (auth)

35672 (AERE-R-4393) A METHOD FOR THE DECOMPOSITION OF AMMONIUM NITRATE IN AQUEOUS SOLUTION. R. L. Faircloth (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). July 1963. 26p.

A method is suggested for the decomposition of ammonium nitrate contained in effluent liquors. This involves the electrochemical reduction of the nitrate to ammonium nitrite with subsequent decomposition, by heating, to nitrogen and water. The feasibility of the method was studied by means of a number of electrochemical experiments designed to test various electrode systems. A series of chemical experiments, in which the rate constant for the decomposition of ammonium nitrite was determined, were also carried out. Various theoretical aspects of the system are discussed. (auth)

35673 (ANL-6741) A PRACTICAL APPROACH TO AVAILABILITY AND IRREVERSIBILITY. Barton M. Hoglund (Argonne National Lab., Ill.). June 1963. Contract W-31-109-eng-38. 31p.

Analysis of the Second Law of Thermodynamics is discussed. Keenan's approach to availability and irreversibility is modified so that the expression for the efficiency of a reversible engine is used in place of the definition of the thermodynamic temperature scale. Equations are developed for expressing the change in availability and the magnitude of irreversibility for non-flow, semi-flow, and steady-flow systems. The equations are arranged to show which portions of the losses came from friction and from irreversible heat transfer. (D.L.C.)

35674 (BNL-6551) THE CALCULATION OF ZERO-POINT ENERGIES OF MOLECULES BY PERTURBATION

METHODS. Max Wolfsberg (Brookhaven National Lab., Upton, N. Y.). [196?]. Contract [AT(30-2)-Gen-16]. 25p.

Two methods are proposed for calculating zero-point energies of molecules. The first uses the fact that the quantum mechanical Hamiltonian for a vibrating system can easily be written down. The zero-point energy is then obtained by a perturbation scheme without solving the secular equation. The second method requires a knowledge of the normal modes and frequencies of a reference molecule, but then permits calculation of isotope effects by a perturbation scheme. The methods are applied to some examples, and the convergence of the perturbation series is investigated. The approximate validity of the law of the mean for the isotope effect on zero-point energies is explored within the framework of the methods. (auth)

35675 (BNL-6561) THE FUNCTION OF BRIDGING GROUPS IN ELECTRON-TRANSFER REACTIONS. N. S. Hush (Brookhaven National Lab., Upton, N. Y.). [nd]. Contract [AT(30-2)-Gen-16]. 28p.

Electron-transfer reactions involving bridged transition states are examined from the point of view of adiabatic electron transfer theory. One important function of the bridging group is found to be a decrease of the effective dipole moment of the charge system of the reacting ions. The effect on the activation energy is different for outer-sphere and inner-sphere reactions. Trends in the halide and hydroxide catalysis of isotopic exchange reactions of transition metal ions are discussed. (auth)

35676 (BNL-6828) X-RAY INVESTIGATION OF THE CRYSTAL STRUCTURE OF XENON TETRAFLUORIDE. Walter C. Hamilton and James A. Ibers (Brookhaven National Lab., Upton, N. Y.). [1963]. Contract [AT(30-2)-Gen-16]. 16p. (CONF-126-6)

From Conference on Noble Gas Compounds, Argonne, Ill., Apr. 1963.

The crystal structure of the low-density phase of xenon tetrafluoride, reported earlier, was refined further. The average Xe–F bond length, uncorrected for thermal motion, is 1.94 ± 0.02 A. The F–Xe–F bond angle is 90.8 ± 1.1°. As the molecule is required by the space group symmetry to be planar and centrosymmetric, these results indicate that any departures from a square planar configuration for the molecule are insignificant. The thermal vibrations of the molecule, as derived from the anisotropic thermal parameters, are readily interpreted in terms of rigid body translations and rotations with root-mean-square amplitudes of approximately 0.12 A and 6°, respectively. The latter correspond to torsional oscillations with frequencies of about 50 to 70 cm^{-1}. (auth)

35677 (CONF-39-87) CHARACTERISTICS OF SUB-STOICHIOMETRIC URANIA (UO_{2-x}) AT ELEVATED TEMPERATURES. E. A. Aitken, H. C. Brassfield, and J. A. McGurty (General Electric Co. Advanced Technology Services, Cincinnati). [nd]. Contract AT(40-1)-2847. 10p. (TM-63-7-12).

From American Nuclear Society 9th Annual Meeting, Salt Lake City, June 1963.

Metallographic examination of UO_2 heated to 2000°C in H_2 or He and then cooled to room temperature showed two phases, UO_2 and free U. Experiments were made at 2200 to 2600°C to correlate the volatility of UO_2 with the degree of oxygen deficiency. The results showed that the final composition at 2400°C was $UO_{1.88}$ in H_2 and $U_{1.94}$ in He and that the mechanism of substoichiometry is by volatilization of uranium oxides. Indirect evidence is presented for the nonexistence of free U metal at 2400°C. (D.L.C.)

35678 (CONF-72-4) CRYSTAL STRUCTURE AND MELTING POINT ON CURIUM METAL. B. B. Cunningham and J. C. Wallmann (California. Univ., Berkeley. Dept. of Chemistry and California. Univ., Berkeley. Lawrence Radiation Lab.). [1963]. Contract [W-7405-eng-48]. 12p.

From Transplutonium Element Symposium, Argonne, Ill., May 1963.

Curium metal was found to crystallize in a double hexagonal-close-packed structure, similar to that of alpha lanthanum. The lattice parameters are a = 3.496 ± 0.003 Å and c = 11.331 ± 0.005 Å. The melting point of the metal was observed to be 1340 ± 40°C. (auth)

35679 (CONF-126-11) CHARACTERIZATION OF OCTAVALENT XENON IN AQUEOUS SOLUTION. Evan H. Appleman (Argonne National Lab., Ill.). [nd]. Contract W-31-109-eng-48. 16p.

From Conference on Noble Gas Compounds, Argonne, Ill., Apr. 1963.

Aqueous solutions of Xe^{8+} were prepared from the solid sodium perxenate obtained by alkaline hydrolysis of XeF_6. At high pH these solutions decompose slowly to Xe^{6+} and oxygen, the rate increasing with decreasing pH. The standard potential in basic solution for the $Xe^{6+}-Xe^{8+}$ couple is estimated to lie between −0.7 and −1.24 v. The ultraviolet spectrum of Xe^{8+} is given as a function of pH, and potentiometric acid–base titrations of both Xe^{8+} and Xe^{6+} are presented. A series of protonation equilibria is postulated to explain the observations. (auth)

35680 (CONF-126-18) INFRA-RED ABSORPTION SPECTRA OF SOME HEAVY METAL PERXENATES. Dieter M. Gruen (Argonne National Lab., Ill.). [1963]. Contract [W-31-109-eng-38]. 14p.

From Conference on Noble Gas Compounds, Argonne, Ill., Apr. 1963.

A study of the infrared spectra of Na, U, Pb, and Ag perxenates was conducted to understand the Xe–O bonding properties in these compounds. All the spectra show an intense band in the 650 to 680 cm^{-1} region, which may be identified with the $\nu_3(f_{1u})$ vibration of the octahedral $[XeO_6]$ grouping. The possible structures of xenate and perxenate ions and compounds are discussed. (D.L.C.)

35681 (EUR-366.e) LATTICE VIBRATIONAL SPECTRUM OF VANADIUM. K. Krebs (European Atomic Energy Community Nuclear Research Center, Ispra, Italy). 1963. 20p.

The lattice vibrational spectrum of vanadium was calculated on the basis of four different force models. The comparison with a spectrum measured by neutron techniques showed that none of these standard models is completely satisfactory. (auth)

35682 (HW-SA-2830) THE ULTRAVIOLET ABSORPTION SPECTRUM OF RUTHENIUM TETROXIDE VAPOR. G. B. Barton (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). [Nov. 6, 1962]. Contract AT(45-1)-1350. 4p.

The absorption spectra of ruthenium tetroxide were measured. The molar extinction coefficient was determined by absorbing the ruthenium tetroxide from a measured volume of air into a solution of 1M NaOH–0.05M NaOCl, which was then measured spectrophotometrically. It was found to be 930 at 3835 Å. The regular spacing of the band components indicated a somewhat lower frequency for the $\nu_1(A_1)$ vibration that was calculated by Ortner (760 vs 890 cm^{-1}). (M.C.G.)

35683 (HW-SA-2837) MASS ACTION RELATIONSHIPS OF SOME ZEOLITES IN THE REGION OF HIGH

COMPETING CATION CONCENTRATIONS. L. L. Ames, Jr. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Nov. 12, 1962. Contract AT (45-1)-1350. 23p.

Mass action quotients for the synthetic zeolites Linde 4AXW, 13X, AW-300, AW-400, AW-500, Norton Zeolon, and the natural zeolites clinoptilolite and erionite were determined for low cesium or strontium concentrations in the binary systems cesium-sodium, cesium-potassium, cesium-rubidium, strontium-calcium, and strontium-sodium. The equilibrium systems cesium-hydrogen and strontium-hydrogen were determined for the zeolites Linde AW-300, Norton Zeolon, and clinoptilolite. A portion of the ternary system hydrogen-sodium-cesium was determined for clinoptilolite. Cesium mass action quotients generally declined in going from cesium-sodium to cesium-rubidium systems. Structural differences between two members of the same zeolite species often resulted in cation exchange equilibria differences as great as those between different species. The binary curves may be used to determine column loading of the above zeolites. (auth)

35684 (IA-809) SPECTROPHOTOMETRY OF LANTHANIDE NITRATES IN SOLUTION. I. Abrahamer and Y. Marcus (Israel. Atomic Energy Commission, Rehovoth). Jan. 1963. 26p.

The effect of high concentrations of nitrate ions on the spectra of lanthanide ions in solution is considerable, even though the transitions responsible for the spectra are between well shielded orbitals. The changes in the spectra are sensitive to the solvent medium and to the concentrations of water and nitrate. Qualitative interpretation of these effects, in terms of specific hydration and complexation, is presented; further results are required for a more quantitative explanation. (auth)

35685 (IS-560) GEM-BIS(DISUBSTITUTEDPHOSPHINYL)ALKANES. III. CRYSTALLINE COMPLEXES OF BIS(DI-2-ETHYLBUTYLPHOSPHINYL)METHANE WITH URANIUM(VI) NITRATE AND WITH THORIUM NITRATE. James R. Parker and Charles V. Banks (Ames Lab., Ames, Iowa). [Oct. 16, 1962]. Contract [W-7405-eng-82]. 9p.

Bis(di-2-ethylbutylphosphinyl)methane, EBDPM, forms complexes with uranium(VI) nitrate and thorium(IV) nitrate in which EBDPM acts as a bidentate ligand and the nitrato groups appear to be coordinated. The complex with uranium(VI) is a monomer, $UO_2(NO_3)_2$(EBDPM), whole the complex with thorium is a dimer, $[Th(NO_3)_4]_2$(EBDPM)$_3$. Both complexes are of high thermal stability. (auth)

35686 (IS-589) THERMODYNAMICS OF FORMATION OF $ThMg_2$. D. B. Novotny and J. F. Smith (Ames Lab., Ames, Iowa). [Jan. 11, 1963]. Contract [W-7405-eng-82]. 6p.

The thermodynamic functions for the formation of $ThMg_2$ were determined by measuring the equilibrium vapor pressure of Mg over Th–$ThMg_2$ two-phase alloys at 692 to 812°K. The data show that for the reaction $ThMg_2(s) \rightleftharpoons 2Mg(g) + Th(s)$, the vapor pressure may be expressed as $\log_{10}p$ (mm Hg) = $(-9130 \pm 210)/T + 10.3 \pm 0.3$. This equation and the vapor pressure of pure solid Mg were used to obtain the free energy of formation of $ThMg_2$ from the pure solid elements: $\Delta F°$ (kcal/mole) = $-14.3 \pm 3.1 + (15.2 \pm 4.3) \times 10^{-3}$ T. This equation indicates that $ThMg_2$ should be unstable above 942°K, which is considerably below the observed peritectic reaction at 780°C. A tentative revision of the equation gives $F° = -15.2 \pm 14.4 \times 10^{-3}$ T. (D.L.C.)

35687 (IS-596) SOLUTION OF METALS IN THEIR MOLTEN SALTS. SOME MANGANESE, CHROMIUM, URANIUM AND ANTIMONY SYSTEMS. John D. Corbett, Ronald J. Clark, and Theodore F. Munday (Ames Lab., Ames, Iowa). Jan. 14, 1963. Contract W-7405-eng-82. 12p.

Preparations of high purity $MnCl_2$, $CrCl_2$, CrI_2, UBr_4, UI_3 and Sb_2S_3 are described; the melting points obtained for CrI_2 (868°) and Sb_2S_3 (559.5°) are significantly higher than previously reported. The small solubilities of manganese and chromium in the respective halides studied were characterized primarily by the depression of the freezing points of the salts by excess metal. For $MnCl_2$ + Mn (in Ta), ΔT is 1.5 ± 1°, for $CrCl_2$ + Cr, 6°, and for CrI_2 + Cr, 3°. The UBr_3–U and UI_3–U systems were studied by equilibration in tantalum containers followed by analysis of the saturated salt phase. Uranium dissolves in liquid UBr_3 to 4 ± 1 mole per cent over the range of 800 to 912°, and in $UI_3(\ell)$, from 5.7 per cent at 784° to ~9 per cent at 1020°. The liquidus curve for Sb_2S_3 + Sb was investigated by thermal analysis; the salt-rich eutectic is at 524–5° and 18.0 ± 0.5 per cent Sb. At 780° the equilibrium salt phase contains 42.0 ± 0.5 per cent Sb. The UBr_3 and Sb_2S_3 compositions are somewhat lower in metal content than previously reported. (auth)

35688 (LADC-5555) HEAT CAPACITY OF PLUTONIUM DIOXIDE BELOW 325°K. Thomas A. Sandenaw (Los Alamos Scientific Lab., N. Mex.). [1962]. Contract [W-7405-eng-36]. 25p.

The low-temperature heat capacity behavior of PuO_2 was found to be anomalous and irreproducible, changing slightly after every one of seven liquid helium coolings. Data obtained from a second series of liquid helium coolings, made after refiring three of four original PuO_2 wafers in air, were consistent with the last run of the first series. The final low-temperature heat capacity vs temperature curve was more like that reported for ThO_2 than it was for similar curves reported for UO_2 and NpO_2. A least squares equation relating heat capacity and temperature is given for the low-temperature region. Values of heat capacity, entropy, and enthalpy are listed for several temperatures. (auth)

35689 (LADC-5709) THE PREPARATIVE CHEMISTRY OF THE ACTINIDE METALS. L. B. Asprey (Los Alamos Scientific Lab., N. Mex.). Mar. 14, 1963. Contract W-7405-eng-36. 9p. (CONF-14-34)

From American Chemical Society 144th National Meeting, Los Angeles, Mar. 1963.

A brief review is presented of the occurrence, general methods of purification, preparative chemistry, and some of the physical properties of the metal for the actinides from Ac to Cm. The heavier elements beyond Cm are also considered briefly. (D.L.C.)

35690 (LADC-5861) FLUORIDE COMPLEXES OF PENTAVALENT URANIUM. R. A. Penneman, G. D. Sturgeon, and L. B. Asprey (Los Alamos Scientific Lab., N. Mex.). [1963]. Contract [W-7405-eng-36]. 17p. (CONF-184-1)

From Symposium on Inorganic Fluorine Chemistry, Argonne, Ill., Sept. 1963.

Synthesis and characterization of complex fluorides containing alkali metals or ammonium and U(V) in the non-oxygenated form are reported. $LiUF_6$, $NaUF_6$, Na_3UF_8, KUF_6, K_2UF_7, K_3UF_8, $RbUF_6$, Rb_2UF_7, Rb_3UF_8, $CsUF_6$, Cs_2UF_7, Cs_3UF_8, NH_4UF_6, $(NH_4)_2UF_7$, and $(NH_4)_3UF_8$ were prepared by heating anhydrous UF_5 with the appropriate

fluoride in a bomb at temperatures up to 350°. X-ray-powder patterns were obtained and the absorption spectrum of each compound measured. Strong absorption in the region 1.3 to 1.5 μ was found for these compounds. In addition, U(V) was found to form relatively stable, bright-blue solutions in aqueous 48% HF. The solubility of U(V) can exceed 5 moles/liter. Upon cooling a saturated solution of U(V) in 48% aqueous HF, blue crystals having the composition $HUF_6 \cdot 2.5H_2O$ precipitated. The 1:1 MF to UF_5 compounds of all except sodium were made by adding the suitable fluoride to such a solution of U(V) in HF. Impure preparations of some 2:1 and 3:1 compounds were also obtained. (auth)

35691 (LADC-5871) THE CALORIMETRY OF COMBUSTIONS AND RELATED REACTIONS: INORGANIC REACTIONS. Charles E. Holley, Jr. (Los Alamos Scientific Lab., N. Mex.). [1962]. Contract W-7405-eng-36. 28p. (CONF-180-1)

From Symposium on Thermodynamics and Thermochemistry, Lund, Sweden, July 1963.

A review is presented of calorimetric measurements of the heats of combustion and other reactions. The precision of the measurements is discussed, and possible sources of error in combustion calorimetry are considered. Measurement of the heats of formation of the oxides and other compounds is also discussed. Recent developments in calorimetry are described briefly, including the rotating bomb calorimeter, use of gases other than oxygen, fluorine bomb calorimetry, and combustion bomb with window. Tables are presented of the heats of reactions measured by oxygen bomb calorimetry, nitrogen bomb calorimetry, and fluorine bomb calorimetry. (D.L.C.)

35692 (LADC-5913) RECENT DEVELOPMENTS IN THE CHEMISTRY OF AMERICIUM AND CURIUM. Thomas K. Keenan (Los Alamos Scientific Lab., N. Mex.). [1963]. Contract [W-7405-eng-36]. 12p. (CONF-183-1)

From Hot Laboratory Conference, Argonne, Ill., May 1963.

A brief summary is given of recent developments in the inorganic chemistry of Am and Cm. The topics discussed include disproportionation of Am(V), behavior of Am(VI) in carbonate and bicarbonate solutions, complexes of Am and Cm with common inorganic ligands, and preparation of Am(IV) and Cm(IV) in solution. (D.L.C.)

35693 (NP-12983) ÉTUDE DE L'ADSORPTION IONIQUE SUR DIVERSES SURFACES À L'AIDE DES RADIO-INDICATEURS (THÈSE). (Study of Ion Adsorption on Various Surfaces by Means of Radio-Indicators (thesis)). Jacqueline Belloni-Cofler (Paris. Université). 1961. 61p.

The variations of the adsorption of Pm, Ce, Zr, Nb, T, and sulfate ions on Pt, Au, Ag, stainless steel, glass, and polyvinyl chloride were studied as a function of pH, concentration, time, temperature, nature of the surface, and the reversibility of the reaction. The methods used for the determinations of the tracers on the adsorbent surface are described. The kinetics of the adsorption and desorption, the adsorption isotherms, and simultaneous adsorption of sulfate and Pm ions were determined. The results are interpreted with respect to the hypotheses of previous authors. The adsorption mechanism of the different ions of the solution is defined, and the effect of the concentration of each of them on the total adsorption is determined quantitatively. (J.S.R.)

35694 (NYO-4691) HIGH TEMPERATURE HEATS OF MIXING FOR THE LIQUID COPPER–TIN SYSTEM AND THE LIQUID COPPER–NICKEL SYSTEM. M. G. Benz and J. F. Elliott (Massachusetts Inst. of Tech., Cambridge. Dept. of Metallurgy). Aug. 27, 1963. Contract AT(30-1)-1888. 36p.

A new type of solution calorimeter was constructed to measure heats of mixing, enthalpy increments, and heats of fusion, formation, and reaction at temperatures above 1000°C. With it, measurements were made of the partial molar heats of mixing for tin in the copper–tin system from 0 to 13 at.% Sn at 1127°C and for nickel in the copper–nickel system from 0 to 9 at.% Ni at 1200°C. The integral molar heat of mixing for the copper–tin system is strongly negative with a minimum value corresponding to the composition Cu_3Sn. The integral molar heat of mixing for the copper–nickel system is slightly positive at these temperatures. These integral molar values were measured with a probable error less than 30 cal/gm atom at an atom fraction of nickel or tin equal to 0.1. The estimated probable error for the copper–tin system is approximately 450 calories for a measured heat of solution of approximately 9000 calories. For the copper–nickel system it is approximately 700 calories for a measured heat of solution of approximately 6000 calories. (auth)

35695 (ORNL-3411) REVIEW OF ELECTRONIC ABSORPTION SPECTRA OF MOLTEN SALTS. G. P. Smith (Oak Ridge National Lab., Tenn.). Sept. 4, 1963. Contract W-7405-eng-26. 65p.

The results of investigations of electronic absorption spectra of molten salts are reviewed with the primary aim of providing a guide to the literature for those doing experimental research. The period covered is 1916 through mid-1962, with, however, most of the research concentrated on the period since 1956. Literature citations number 160 and include a large number of references to theoretical articles. The kinds of chromophores treated include transition-metal ions, lanthanide-metal ions, actinide-metal ions, halide ions, oxy-anions, and solutions of metals and halogens in molten salts. Typical spectra are illustrated. The results of background theory necessary for interpretation of experimental results are given. (auth)

35696 (ORNL-TM-462) HYDROLYSIS OF URANIUM CARBIDES BETWEEN 25 AND 100°. II. AS-CAST ALLOYS CONTAINING 2 TO 10 WT % CARBON. Mildred J. Bradley and Leslie M. Ferris (Oak Ridge National Lab., Tenn.). Jan. 21, 1963. Contract W-7405-eng-26. 16p.

Reactions with water of as-cast uranium-carbon alloys containing 2 to 10 wt % carbon ($UC_{0.4}$ to $UC_{2.2}$) were investigated by using gas-chromatography for analysis of the gaseous products. Uranium metal-uranium monocarbide alloys yielded 2 moles of free hydrogen per mole of free metal, in addition to methane, small quantities of higher molecular weight gaseous hydrocarbons, and a solid, hydrous, tetravalent uranium oxide. The gaseous products contained all the carbon originally present in the alloy. Uranium dicarbide ($UC_{1.86}$; this combined-C/U atom ratio was the maximum which could be obtained) yielded a mixture of 36 hydrocarbons (methane, 15 vol %; ethane, 28%; C_3- to C_8-alkanes, 7%; alkenes, 8%; alkynes, 0.6%; and unidentified unsaturates, 1%), free hydrogen (40 vol %), a water-insoluble wax, and a solid, hydrous, tetravalent uranium oxide. Forty % of the combined carbon was found in the gas and 25% in the wax. The gaseous products from the hydrolysis of both UC and $UC_{1.86}$ were not affected by changes in the reaction temperature between 25 and 99°. The composition of the gases evolved at 80° from as-cast alloys with compositions between UC and $UC_{1.86}$ varied linearly with the combined-C/U atom ratio of the alloy;

however, the amounts of methane produced were lower than expected from the UC concentrations in the alloys. (auth)

35697 (RAE-TN-MET-PHYS-361) THE STRUCTURE OF PYROLYTIC CARBON. J. Harvey, D. Clark, and J. N. Eastabrook (Gt. Brit. Royal Aircraft Establishment, Farnborough, Hants, England). Oct. 1962. 21p.

X-ray diffraction with electron and optical microscopy were used in the study of pyrolytic carbon deposits prepared in the range 850 to 2100°C. Investigations of material deposited on an electrically heated rod indicated that a severe temperature gradient was set up in the growing layer, leading to marked annealing of the inner layers. Substrate roughness was found to account for the growth of the large cones visible optically when the material is viewed in section. Preferred orientation measurements showed that greatest misorientation occurred for material deposited at about 1700°C (corresponding to the density minimum). Preliminary graphitization studies showed that a 2000°C deposit did not graphitize completely at about 2400°C but reached a quasi-stable state in which 60 to 70% of the layer planes were oriented as in the ideal graphite structure. No changes in preferred orientation or macroscopic dimensions occurred but electron microscope observations suggested that a kind of polygonization had taken place. Material with c planes inclined to the surface graphitized less readily than that with c planes parallel. The results are interpreted in terms of a proposed structure resulting from the incorporation, in the growing deposit, of small carbon black particles from the gas phase. (auth)

35698 (TID-17035) THE EFFECTS OF ELECTRONIC POLARIZABILITY ON ELECTRIC BREAKDOWN STRENGTH. O. Brill and E. Franzak (Sandia Corp., Albuquerque, N. Mex.). [Oct. 1962]. Contract [AT(29-1)-789]. 7p. (SCDC-2902)

The ionic shell model is used in a calculation of electric breakdown strength based on single electron considerations. An identification is made between terms characteristic of the model and an effective ionic charge. Numerical calculations are carried out for NaI where, with an effective charge of 0.71e, the ionic character is determined to be 0.40e. This is in reasonable agreement with a previous estimate of Pauling of 0.47e. (auth)

35699 (TID-17418) COMPLEXES OF URANYL ION WITH DIMETHYLFORMAMIDE AND SEMICARBAZIDE. Norman A. Frigerio and Ronald F. Coley (Argonne National Lab., Ill. and Saint Procopius Coll., Lisle, Ill.). Sept. 1962. Contract W-31-109-eng-38. 5p. (UAC-6883)

When uranyl acetate dihydrate was refluxed with dimethylformamide and cooled to 0°C, yellow crystals of uranyl dimethylformamide acetate, $UO_2(HCON(CH_3)_2)(CH_3COO)_2$, were precipitated. When uranyl nitrate hexahydrate was refluxed with dimethylformamide, $UO_2(HCON(CH_3)_2)_2(NO_3)_2$ was obtained. Semicarbazide underwent similar reactions but did not replace all of the waters in the solvation shell; $UO_2(H_2O)_3(NH_2CONHNH_2)_3Cl_2$ was obtained from several uranyl salts and semicarbazide hydrochloride in the presence of pyridine. Attempts to prepare uranyl complexes containing both semicarbazide and dimethylformamide failed. $UO_2(HCON(CH_3)_2)_3(NO_3)_2$ was reacted with lithium phthalocyanine in acetone to form uranyl phthalocyanine. (D.L.C.)

35700 (TID-17478) ZIRCALOY PICKLE BATH SALTS. CHEMICAL NATURE AND THERMAL DECOMPOSITION OF HYDRATED ZIRCONIUM FLUORIDE. J. Rynasiewicz (Knolls Atomic Power Lab., Schenectady, N. Y.). [1962]. Contract [W-31-109-eng-52]. 15p.

Zircaloy is usually pickled with 3.8 vol % HF–39 vol % HNO_3 before being autoclaved in water and steam to form a passive black oxide film on its surface. This pickling method entails the possibility of retaining residual etchant fluoride on the surface, which may shorten the life of Zircaloy in reactor fuel elements. White crystals were found in the spent etch solution and determined by chemical analysis to be pure $ZrF_4 \cdot 3H_2O$. The thermal decomposition of this substance in air was studied and found to proceed in three steps, resulting in $ZrF_4 \cdot H_2O$ above 200°C, $Zr_2(OH)F_7$ above 345°C, and ZrO_2 above 845°C. (D.L.C.)

35701 (TID-17487) OXIDE FORMATION ON MAGNESIUM SINGLE CRYSTALS. I. KINETICS OF GROWTH. Richard L. Schwoebel (Cornell Univ., Ithaca, N. Y.). [Dec. 1962]. Contract [AT(29-1)-789]. 37p. (SCDC-2963)

The kinetics of oxide film formation on the basal and prismatic planes of magnesium single crystals were investigated using an ultra-high vacuum microbalance system. A parabolic rate law describes the oxide film growth in an average thickness range of 50 to 1000 Å when formed at 400°C and 2.5 torr oxygen pressure. The parabolic rate constant varies approximately as the one-sixth power of the oxygen pressure. If the rate constant is expressed in terms of the Arrhenius expression, $\exp(-E_{act}/RT)$, the experimental activation energy for oxidation of high-purity samples is $E_{act} = 39 \pm 3$ kcal/mole. These three results are consistent with the Wagner-Hauffe theory of oxide growth by diffusion of lattice defects. The activation energy for oxidation can be shown to be the sum of the energy for extrinsic diffusion of cation vacancies in the oxide and one-third of the energy required to create a vacancy at the oxide-oxygen interface. Furthermore, the experimental parabolic rate constant can be calculated approximately by consideration of the associated interfacial defect equation. The kinetics of oxidation for crystals containing impurities of various valencies substantiate the hypothesis that the defect nature of the oxide is determined primarily by the formation of cation vacancies at the oxide-oxygen interface. It is postulated that vacancy formation at the interface is related to an oxygen adsorption-dissociation process occurring at selected sites on the oxide surface. (auth)

35702 (TID-17505) PROPOSED MECHANISMS FOR THE U(IV)–U(VI) EXCHANGE REACTION IN AQUEOUS-ORGANIC MIXED SOLVENT SYSTEMS. James O. Wear (Sandia Lab., Albuquerque, N. Mex.). [Oct. 1962]. Contract [AT(29-1)-789]. 35p. (SCDC-2958)

Mechanisms are written and discussed for the U(IV)–U(VI) exchange reaction in the following mixed solvents: 30, 60, 90, and 98 volume per cent ethanol-water; 30, 60, 90, and 98 volume per cent ethylene glycol-water; and 30, 60, and 90 volume per cent acetone-water. It is found that in all cases the experimental data can be explained by one two-electron exchange by means of oxygen group transfer. (auth)

35703 (TID-17786) HIGHER OXIDES OF NEPTUNIUM. Donald Cohen (Argonne National Lab., Ill.). Oct. 1962. Contract [W-31-109-eng-38]. (UAC-6926)

A summary is given of work on the oxides of Np(V) and Np(VI) prepared from molten salts. These oxides were precipitated when O_3 was bubbled through solutions of Np(V) in a $LiNO_3$–KNO_3 eutectic at 150°C and in molten $LiClO_4$ at 260°C (no precipitate formed in Np(VI) solutions). The Np(VI) precipitate usually was formed from the nitrate melt and the Np(V) from the $LiClO_4$ melt. Evidence is

presented for the structures $Np_2O_5 \cdot H_2O$ and $NpO_3 \cdot 2H_2O$ for these precipitates. (D.L.C.)

35704 (TID-17807) OXIDE FORMATION ON MAGNESIUM SINGLE CRYSTALS. II. STRUCTURE AND ORIENTATION. Richard L. Schwoebel (Sandia Corp., Albuquerque, N. Mex.). Dec. 1962. Contract AT(29-1)-789. 22p. (SCDC-2979)

Thesis submitted to Cornell Univ.

The separation and examination of oxide films of 100 to 200 A thickness from magnesium single crystals is described. The film separation is accomplished by sublimation of the metal crystal leaving large areas of the oxide film intact at the sublimation site. Electron microscopy and selected area diffraction were used to determine the continuity, crystallite size, and epitaxy of the oxide films. This information is particularly useful in establishing a mechanism for the kinetics of oxide film growth described in Part I. (auth)

35705 (TID-19276) DEHYDRATION KINETICS AND EQUILIBRIUM WATER VAPOR ADSORPTION BY THORIA GEL. Technical Report No. XX. Byong D. Chun, M. E. Wadsworth, and F. A. Olson (Utah. Univ., Salt Lake City. Inst. of Metals and Explosives Research). July 31, 1963. For Oak Ridge National Lab., Tenn. Contract W-7405-eng-26, Subcontract 2176. 14p.

Equilibria and kinetic studies of thoria gel dehydration indicated that water adsorbed in the temperature range room temperature to about 140°C is hydrogen bonded in a state very similar to liquid water. The principal difference is that the hydrated water is somewhat less ordered (slightly larger entropy) than liquid water and the equilibrium temperature at one atmosphere water vapor partial pressure is 137°C instead of 100°C for bulk water equilibrium. In order for the thoria to adsorb water by hydrogen bonding in a manner similar to bulk water it is evident that up to 140°C, surface species such as hydroxyls, nitrates, and possibly carbonates must be the adsorption sites. The bulk of the dehydration at temperatures up to about 140°C is first order. There is evidence from the entropy of activation that the water in the activated complex, i.e., configuration for desorption, is highly ordered. (auth)

35706 (TID-19307) SORPTION OF GASES ON METAL SURFACES IN ULTRAHIGH VACUUM. Quarterly Progress Report No. 4, February 15 to May 15, 1963. (Stanford Research Inst., Menlo Park, Calif.). June 26, 1963. Contract AT(04-3)-425. 20p.

A molybdenum film was prepared in the film unit at pressures of about 5×10^{-10} torr and the sorption of nitrogen by the film was investigated as function of pressure and at two temperatures, 30°C and liquid nitrogen. The mass spectrometer was further tested, and the interaction of hydrogen-deuterium mixture with the system was studied. In a search for low temperature electron emitters, barium hexaboride was prepared and tested; it proved to be unsuitable because barium metal is released at fairly low temperatures. (auth)

35707 (UCRL-7343-T) THE HEAT OF FORMATION OF XENON TRIOXIDE. Stuart R. Gunn (California. Univ., Livermore. Lawrence Radiation Lab.). May 3, 1963. Contract W-7405-eng-48. 7p. (CONF-126-17).

From Conference on Noble Gas Compounds, Argonne, Ill., Apr. 1963.

The heat of explosion of XeO_3 was measured calorimetrically; the derived heat of formation is $+96 \pm 2$ kcal/mole^{-1}. (auth)

35708 (UCRL-10803) DETERMINATION OF THE CRYSTAL STRUCTURE OF XENON TRIOXIDE. David H. Templeton, Allan Zalkin, J. D. Forrester, and Stanley M. Williamson (California. Univ., Berkeley. Dept. of Chemistry and California. Univ., Berkeley. Lawrence Radiation Lab.). Apr. 1963. Contract W-7405-eng-48. 15p. (CONF-126-15)

From Conference on Noble Gas Compounds, Argonne, Ill., Apr. 1963.

Xenon trioxide was characterized by determination of its crystal and molecular structure by x-ray diffraction by single crystals. Four molecules of XeO_3 occupy an orthorhombic cell in space group $P2_12_12_1$ with dimensions $a = 6.163 \pm 0.008$ Å, $b = 8.115 \pm 0.010$ Å, $c = 5.234 \pm 0.008$ Å. The crystal structure is closely related to that of the isoelectronic HIO_3. The XeO_3 molecule has trigonal pyramidal shape with average Xe–O bond length 1.76 Å (corrected for thermal motion) and average O–Xe–O bond angle 103°. (auth)

35709 (UCRL-10804) A DETERMINATION OF THE CRYSTAL STRUCTURE OF XENON TETRAFLUORIDE. David H. Templeton, Allan Zalkin, J. D. Forrester, and Stanley M. Williamson (California. Univ., Berkeley. Dept. of Chemistry and California. Univ., Berkeley. Lawrence Radiation Lab.). Apr. 1963. Contract W-7405-eng-48. 15p. (CONF-126-16)

From Conference on Noble Gas Compounds, Argonne, Ill., Apr. 1963.

The crystal and molecular structure of XeF_4 was determined by single-crystal x-ray-diffraction techniques. The intensities of MoKα x rays diffracted by the crystal were measured with a scintillation counter. The monoclinic unit cell dimensions are $a = 5.050$ Å, $b = 5.922$ Å, $c = 5.771$ Å (each ± 0.003 Å), and $\beta = 99.6° \pm 0.1°$. The space group is $P2_1/n$ with two molecules per unit cell. The xenon atoms occupy the corners and body centers so that the molecular packing is pseudo body-centered cubic. The molecule has a square planar configuration. The Xe–F bond distance is 1.93 ± 0.02 Å, after a correction of $+0.02$ Å for thermal vibration effects; the F–Xe–F bond angle is a right angle ($90.4 \pm 0.9°$) within the accuracy of the determination. (auth)

35710 (UJV-528) THE SORPTION OF MICROSTRONTIUM AND MICROCESIUM ON THE SILICATE MINERALS AND ROCKS. Lubomir Berák (Československá Akademie Věd. Ustav Jaderného Výzkumu, Řež). June 1963. 40p.

A large number of silicate minerals and rocks were studied for their sorptive properties for microquantities of Sr and Cs from synthetic river water containing macro amounts of Ca. The primary silicate minerals were found to have poor sorptive properties, while the secondary minerals had good sorptive properties. Cs is well retained by some silicate species, while Sr is poorly sorbed. The results for rocks support the hypothesis that the alteration process plays an important role in the sorption capacity of the rocks. The zeolite mordenite and devitrified rhyolite rock gave excellent sorption of Cs; the devitrification process was responsible for the sorption activity of mordenite. Feldspars and some zeolites are capable of strong sorption preference for Sr over Ca. (D.L.C.)

35711 THE STRUCTURES OF 1 :1 COMPOUNDS OF RARE EARTH OXIDES WITH NIOBIA AND TANTALA. H. P. Rooksby and E. A. D. White (General Electric Co. Ltd., Wembley, Eng.). Acta Cryst., 16: 888-90 (Sept. 10, 1963). (In English)

The crystal structures of various synthetic ABO_4 compounds, in which A is one of the rare earths La, Ce, Nd, Sm, Gd, Dy, Y, or Sc, and B is either Nb or Ta, were ex-

amined. Most of the compounds are isotypic with the monoclinically distorted scheelite-like structure, identified for a high-temperature-fired specimen of $YTaO_4$. The lattice parameters are recorded. A high-temperature x-ray study of niobium compounds with this structure proved that the monoclinic distortion is progressively reduced with increasing temperature, and a reversible transition to a tetragonal structure occurs below 800°C. With tantalum compounds, no structure transition takes place up to 1300°C, though at 1300°C a marked reduction of the monoclinic distortion is evident. The two scandium compounds are exceptional and have a monoclinic wolframite-like crystal structure. The difference in structure appears to be dictated by the relatively small radius of the scandium cation. With the largest rare-earth cation, La^{3+}, the niobium compound has the monoclinically distorted scheelite-like structure, but the tantalum compound has a different and unidentified structure. (auth)

35712 PMR DETERMINATION OF TRANSITION METAL ION SITES AND MULTIPLICITY OF RARE-EARTH ION SITES IN $CaWO_4$. R. W. Kedzie and M. Kestigian (Sperry Rand Research Center, Sudbury, Mass.). Appl. Phys. Letters, 3: 86-7(Sept. 1, 1963).

The paramagnetic resonance spectra of Mn^{2+}, Fe^{3+}, and Nd^{3+} ions in $CaWO_4$ were investigated, and it was found that Nd^{3+} can occupy both the Ca and W sites whereas Mn^{2+} is found only in the Ca site and Fe^{3+} only in the W site. It is concluded that the $CaWO_4$ lattice can be host to trivalent paramagnetic impurities in either the Ca or W site. (C.E.S.)

35713 HEAT CAPACITY AND THERMODYNAMICAL FUNCTIONS OF ANTIFERROMAGNETIC URANIUM OXYTELLURIDE, UOTe, WITHIN THE RANGE 21 TO 362°K. B. Stalinski, J. Niemiec, and Z. Bieganski (Inst. of Physical Chemistry, Polish Academy of Sciences, Wrocław and Technical Univ., Wrocław, Poland). Bull. Acad. Polon. Sci., Ser. Sci. Chim., 11: 267-70(1963). (In English)

Measurements were made of the heat capacity of UOTe in the range from 21.2 to 362.0°K. The heat capacity curve rose to a maximum value of about 19.5 cal $mole^{-1}$ deg^{-1} at 159.7°K and then fell rapidly on the high-temperature side showing a pronounced lambda-type anomaly of magnetic origin. Thermodynamic functions were calculated from heat capacity data. (M.C.G.)

35714 THE SPECTROPHOTOMETRIC INVESTIGATION OF THE REACTION OF AN URANYL ION WITH MECONIC AND COMENIC ACIDS. A. A. Muk. Bull. Boris Kidrich Inst. Nucl. Sci., 14: 106-7(Apr. 1963). (In English)

Starting with pH 1, meconic and comenic acids react with uranyl ion producing an intense yellow color. The color intensity is constant for pH 2-4 regions, and with an increase of pH it increases and reaches a maximum at about pH 7-8 then rapidly decreases. The uranyl ion complex with meconic acid gives the maximum absorption at 445 mμ (at pH 2-4). A complex with comenic acid has the same maximum but lower molar absorptivity than the first. (P.C.H.)

35715 RADIOCHEMICAL INVESTIGATION OF ELECTRODE PROCESSES ON BISMUTH AMALGAM. V. V. Gorodetskiĭ and V. V. Losev (Karpov Inst. of Physics and Chemistry, Moscow). Dokl. Akad. Nauk SSSR, 151: 361-4 (July 11, 1963). (In Russian)

Bi amalgam was chosen for detailed study for the purpose of clarifying the kinetic phenomena involved in the electrodeposition and anodic dissolution of metals with a valence higher than 2. The discharge and the ionization of Bi were investigated on 5×10^{-6} to 0.3M amalgam electrode with solutions having a concentration between $2^{-6} \times 10$ to 0.02M $Bi(ClO_4)_3$. The radioactive Bi^{210} isotope was used for the experiments which were carried out at 20°C in an $HClO_4$ solution with an ionic force of 2M. It was found that the anode processes take place at a noticeable rate even in the case of strong cathodic polarization, exhibiting a linear correlation between the potential and the logarithm of the current. The value of the transfer coefficient was calculated at $\beta = 2.3\ RT/b' = 1.76 \pm 0.05$ where b′ designates the slope coefficient. The transfer coefficient data indicated that in the low-slope region, $Bi^+ \rightarrow Bi^{2+} + e$ is the limiting process, while at the high-rate region the rate is controlled by the $Bi \rightarrow Bi^+ + e$ reaction. Removal of the third electron probably involves consideration of hydrated particles; they are more easily adsorbed on the positively charged surface of the amalgam. (TTT)

35716 FORMATION OF HD BY THE REACTION OF HYDROGEN ATOMS, GENERATED IN THE GAS PHASE, WITH SOLID DEUTEROPOLYETHYLENE. V. E. Skurat and V. L. Tal'roze (Inst. of Chemical Physics, Academy of Sciences, USSR). Dokl. Akad. Nauk SSSR, 151: 388-91 (July 11, 1963). (In Russian)

The reaction of H with solid hydrocarbons, yielding H_2 and a free radical is of considerable importance, because, together with the recombination reaction, it may clarify the radiolytic formation of H. The interaction of D atoms with the H_2O molecules and with –OH groups was followed, investigating the exchange of light H with deuteropolyethylene (DPE) while disregarding the similar reaction of D with ordinary H. The gaseous pyrolytic products, which could be decomposed by the hot wire technique used, were not taken into account. The H_2 dissociated by the hot tungsten wire was allowed to react with DPE at various temperatures. It was found by plotting the log of the reaction rate, V, versus 1/T that, in the range from –196 to –100°C, V is temperature-independent while from –100 to +110° it follows Arrhenius' law. Exposure of the DPE samples to doses from 100 to 240 Mrad, which resulted in a considerable increase of the cross-linkages, did not cause any noticeable difference in the reaction rates of the irradiated and normal specimens. It was concluded that the value of the energy of activation is not due to a reaction involving the formation of cross-linkages; the rate of formation of HD is not accelerated by radiation. (TTT)

35717 THE POSSIBILITY OF THE SIMULTANEOUS TRANSFER OF HEXAVALENT URANIUM AND SULFUR BY HYDROTHERMAL SOLUTIONS (ON THE BASIS OF EXPERIMENTAL DATA). R. P. Rafal'skiĭ, A. D. Vlasov, and I. V. Nikol'skaya. Dokl. Akad. Nauk SSSR, 151: 432-4(July 11, 1963). (In Russian)

It was assumed that U was transported by hydrothermal solutions in its hexavalent form and was precipitated out as pitchblende and uraninite after reduction to tetravalent state by divalent Fe, lower oxidation forms of S, and organic matter. In previous studies, it was found that U(VI) may be reduced by elementary S when uranyl sulfate solutions are exposed to high temperatures and pressures (Atomnaya Energ., 13: 181(1962) No. 2). This technique was used at initial molar ratios of $S/U \geq 1$. After soaking the solution in an ampoule at the test temperature, the autoclave was rapidly cooled and, after filtering, the total U was determined by the luminescence method and the U(IV) by its reaction with arsenaso. Significant reaction rates were obtained only beyond 360°C; at lower temperatures, long soaking periods, up to 72 hours, were used. It was found that the U content in the solutions, originally containing 10 g/l of U, in equilibrium with the uraninite

ore increases by a factor of about 10 as the temperature is lowered from 350 to 150°C. No U(IV) was found at 200°C, indicating that its concentration must be less than 3 to 5 × 10^{-4} g/l. It was concluded that under the experimental conditions used the U is present at the higher temperatures in its hexavalent form, thus being available in hydrothermal solutions together with the reducing agent; this possibility was admitted earlier only for the carbonate solutions. (TTT)

35718 AQUEOUS CHEMISTRY OF ZIRCONIUM. PART III. DIALYSED ZIRCONYL CHLORIDE-NEUTRAL SALTS SYSTEMS. V. V. Subbanna and A. K. Bhattacharya (Univ. of Saugar, India). Indian J. Chem., 1: 198-9(May 1963).

Neutral salt solutions, when added to dialyzed zirconyl chloride solution, cause an increase in pH of the solution. The order of the effectiveness of the neutral salts in increasing the pH of zirconyl chloride solution is: citrate > oxalate > malate > malonate > succinate = glutarate = adipate = maleate > tartrate > fumarate > glycollate = lactate > formate = acetate > sulphate > chloride = nitrate. The order of effectiveness of the dicarboxylates, monocarboxylates, and so forth, is: oxalate > malonate > succinate = glutarate = adipate, maleate > fumarate, acetate = formate, lactate = glycollate. The order in different groups follows the order of dissociating power of the acids in each group, showing that the rise in pH is due to the hydrolysis of the added salt. (auth)

35719 URANYL ION SODIUM ALIZARIN 3-SULPHONATE CHELATE. PART II. SPECTROPHOTOMETRIC AND ELECTRICAL CONDUCTANCE STUDIES ON THE COMPOSITION AND STABILITY OF THE CHELATE. Suresh C. Srivastava and Arun K. Dey (Univ. of Allahabad, India). Indian J. Chem., 1: 200-2(May 1963).

Uranium (VI) and sodium alizarin 3-sulfonate combine in the ratio of 1:1 to give a violet-colored chelate exhibiting maximum absorbance at 560 mμ. The chelate is stable between pH 3.0 and 7.0. The value of log K (stability constant) was found to be 4.5 ± 0.1 and that of the free energy change of formation ($\Delta F°$) 6.3 ± 0.2 at pH 5.0, temperature 30°C and ionic strength 0.15M.

35720 ON NUCLEAR QUADRUPOLE COUPLING CONSTANTS OF CHLORINE ISOTOPES AND DIPOLE MOMENT OF BrCl MOLECULE. K. L. Narayana and C. Santhamma (Andhra Univ., Waltair, India). Indian J. Phys., 37: 261-74 (May 1963).

A theoretical estimate of chlorine nuclear quadrupole coupling constant in BrCl molecule was made for the two isotopic substitutions (Cl^{35} and Cl^{37}) of chlorine on the basis of the theory developed by Townes and Dailey. The dependence of the chlorine nuclear quadrupole coupling constant and dipole moment on the chemical bonding state of BrCl molecule was investigated. Neither the amount of the hybridization nor the ionicity of the bond could be uniquely determined. However, fixing a probable percentage ionicity of the bond (10% obtained from the electronegativity considerations) it is found impossible to explain the observed coupling constant without the introduction of s% whereas the observed dipole moment cannot be explained without the introduction of d%. The change in quadrupole coupling constant for the isotopic substitution of chlorine is found predominantly due to the change in the corresponding nuclear quadrupole moments. (auth)

35721 MEAN AMPLITUDES OF VIBRATION FOR THE DIOXIDES OF ZIRCONIUM, TITANIUM, SILICON AND BORON. G. Nagarajan (Annamalai Univ., Annamalainagar, India). Indian J. Pure Appl. Phys., 1: 322-3(Sept. 1963).

The vibrational spectra of the dioxides of zirconium, titanium, silicon, and boron are briefly discussed and the force constants for these molecules are calculated on the basis of the group-theoretical method. The computed numerical values of mean-square amplitude quantities, generalized mean-square amplitude quantities, and mean amplitudes of vibration for molecules of these oxides at 0 and 298°K are reported. (auth)

35722 ON THE HYDROGEN EXCHANGE OF SATURATED HYDROCARBONS IN HOMOGENEOUS MEDIA. PART I. V. N. Setkina and D. N. Kursanov (Inst. of Elementary Organic Compounds, Academy of Sciences, USSR). Izv. Akad. Nauk SSSR, Otd. Khim. Nauk, No. 6, 992-5(June 1963). (In Russian)

Hydrogen exchange of saturated hydrocarbons in a homogeneous system was studied in DCl and other acids in nitrobenzene. Kinetics of isotopic exchange reactions of hydrogen atoms in non-saturated hydrocarbons with tertiary carbon atoms and of methylcyclohexane hydrogen atom exchange in pressure of $FeCl_3$ and $SbCl_3$ were studied. (R.V.J.)

35723 ON INVESTIGATION OF THE $CePO_4-H_3PO_4-H_2O$ SYSTEM AT 25°C. A. I. Ul'yanov and T. I. Kazakova (Inst. of General and Inorganic Chemistry, Academy of Sciences, USSR). Izv. Akad. Nauk SSSR, Ser. Khim., No. 7, 1157-64(July 1963). (In Russian)

An analysis of $CePO_4-H_3PO_4-H_2O$ indicated that the system does not form acid phosphates at 25°C and $CePO_4$ slowly dissolves and precipitates into $CePO_4$, H_3PO_4, and H_2O. At lower temperatures the precipitate $CePO_4$ dissolves readily in H_3PO_4 aqueous solutions described by the formula: $CePO_4 + H_3PO_4$ aq → $CePO_4 \cdot H_3PO_4 \cdot$ aq (solution). (R.V.J.)

35724 INDIUM PASSIVATION IN AQUEOUS SOLUTIONS. T. I. Popava and N. A. Simonova (Inst. of Electro-Chemistry, Academy of Sciences, USSR). Izv. Akad. Nauk SSSR, Ser. Khim., No. 7, 1187-91(July 1963). (In Russian)

The process of In passivation in inert solutions (citric acid, alkali, and dilute $HClO_4$ solutions) and in some active solutions takes place in the inhibiting absorption upper layer. Activation by Cl^- and ClO_4^- was confirmed by anode curves taken of indium in citric, perchloric, and hydrochloric acids indicating the displacement of oxygen sorbed on indium by the anions. (R.V.J.)

35725 INFRARED SPECTRA OF OXYORTHOSILICATES OF RARE EARTH ELEMENTS. A. N. Lazarev, T. F. Tenisheva, I. A. Bondar, and N. A. Toropov (Inst. of Silicate Chemistry, Academy of Sciences, USSR). Izv. Akad. Nauk SSSR, Ser. Khim., No. 7, 1220-6(July 1963). (In Russian)

Infrared spectra of $Ln(SiO_4)O$ (Ln = Dy, Eu, Gd, La, Lu, Nd, Sc, Sm, Y, and Yb) separated the pyro- and orthosilicate compounds into three groups according to their constitution diagrams. Spectra of certain oxyorthosilicates exhibited bond oscillations in the Lm–O–Ln bond incorporating O^{2-}. The bonds covalence is increasing from La → Lu (and La → Y → Sc). (R.V.J.)

35726 INFLUENCE OF ISOTOPIC EFFECT ON THE WIDTH OF NUCLEAR QUADRUPOLE RESONANCE IN SOLID CCl_4. A. N. Osipenko (Gorkii State Univ., USSR). Izv. Vysshikh Uchebn. Zavedenii, Fiz., No. 3, 150-2(1963). (In Russian)

Nuclear quadrupole resonance spectra of Cl^{35} in solid CCl_4 was studied using the Douglas method of calculation. The examined specimen contained five types of molecules:

CCl_4^{35}, $CCl_3^{35}Cl^{37}$, $CCl_2^{35}Cl_2^{37}$, $CCl^{35}Cl_3^{37}$, and CCl_4^{37} with relative natural contents of 31.6, 42.2, 21.1, 4.7, and 0.4%, respectively. Splitting of quadrupole resonance lines by the replacement of Cl^{35} by Cl^{37} was analyzed. (R.V.J.)

35727 ULTRACENTRIFUGATION OF URANYL CITRATE CHELATES. Richard L. Gustafson and Arthur E. Martell (Clark Univ., Worcester, Mass. and Illinois Inst. of Tech., Chicago). J. Am. Chem. Soc., 85: 2571-4 (Sept. 5, 1963).

The degrees of polymerization of uranyl citrate chelates corresponding to the empirical formulas $(UO_2Cit)_n^{n-}$ and $(UO_2[OH]_{1.67}Cit)_n^{2.67n-}$ ($H_3Cit = H_3L$ = citric acid) were calculated from data obtained by nonequilibrium ultracentrifugation of the chelates in 1.2M sodium chloride solutions at 25°. A value of $n = 1.99 \pm 0.08$ was obtained for the $(UO_2Cit)_n^{n-}$ system in solutions which varied from 3.8×10^{-2} to 9.6×10^{-2} in molar concentration of chelate, thus giving strong support to the postulate of dimer formation. The data indicated that the $(UO_2[OH]_{1.67}Cit)_n^{2.67n-}$ system is polydisperse, probably consisting chiefly of a mixture of trimers and hexamers in the 10^{-2} to 10^{-1}M concentration range studied. (auth)

35728 VIBRATIONAL ANALYSIS OF THE HEITLER-LONDON POTENTIAL OF H_2. Charles L. Beckel (Georgetown Univ., Washington, D. C.). J. Chem. Phys., 39: 90-3 (July 1, 1963).

The vibrational levels associated with the Heitler–London potential of H_2 were found through use of the first-order WBK approximation. The vibrational energies G as a function of quantum number ν are accurately represented by $G = -D_0(1 - A\nu - B\nu^2)^n$, where D_0 is the Heitler–London dissociation energy and A, B, and n are parameters. The ΔG curve has negative curvature at all ν. At high ν the vibrational levels show the rapid convergence characteristic of covalent molecules. The Heitler–London ΔG curve has very nearly the same shape as the experimental curve for H_2; horizontally displaced to agree with experiment at low ν, the Heitler–London ΔG curve predicts a dissociation energy that is 93% of the experimental value. (auth)

35729 THERMODYNAMIC PROPERTIES OF A MONATOMIC HYDROGEN GAS AT HIGH TEMPERATURES. Irwin Oppenheim and Dennis R. Hafemann (Massachusetts Inst. of Tech., Cambridge). J. Chem. Phys., 39: 101-9 (July 1, 1963).

A study was made of a gas in which the internal and intermolecular degrees of freedom are not separable. Expressions for the partition function and thermodynamic properties are derived for a gas of monatomic hydrogen. The number of bound states of the system is limited by interactions between the hydrogen atoms. The potentials of interaction of hydrogen atoms with protons, electrons, and other hydrogen atoms were estimated, and the partition function was evaluated at a series of densities from 10 to 10^{-5} amagats. The occupation numbers of bound states and the percent ionization were changed significantly by considering atom–atom and atom–proton interactions, but the value of the partition function is only slightly changed relative to that calculated by considering only the effect of interatomic forces upon the single-atom energies. (auth)

35730 FLUORESCENCE AND LIFETIMES OF Eu CHELATES. H. Samelson and A. Lempicki (General Telephone and Electronics Labs., Inc., Bayside, N. Y.). J. Chem. Phys., 39: 110-12(July 1, 1963).

The fluorescent lifetimes of a number of europium chelates were determined in solution and as the solid at a number of temperatures and a range of wavelengths of the fluorescent emission. They are compared with the lifetimes of europium fluorescence in other compounds and it is suggested that the variation in lifetime is a result of the ligand–Eu interaction and that discrepancies in the results of different workers on the same compound are related to the manner of preparation of the chelate. (auth)

35731 ABSORPTION SPECTRUM OF Cs IN THE PRESENCE OF ISOMERIC HYDROCARBONS. Oleg Jefimenko and Reginald J. Exton (West Virginia Univ., Morgantown). J. Chem. Phys., 39: 229-53(July 1, 1963).

The satellite bands and the shifts of the Cs lines in the spectra of Cs-hydrocarbon mixtures were studied. The hydrocarbons were isomers of butene (butene-1, butene-2, isobutene), butane (n-butane, isobutane), pentane (n-pentane, isopentane, neopentane), and hexane (n-hexane, 3-methylpentane, 2,3-dimethylbutane, neohexane). Four different types of satellite bands were observed. The shifts of high members of the Cs principal series extrapolated to relative density 1 were 41, 47, 47, 48, 55, 58, and 61 cm^{-1} for n-pentane, isopentane, n-hexane, 3-methylpentane, 2,3-methylpentane, 2,3-dimethylbutane, neopentane, and neohexane, respectively. The results of simultaneous measurements of the band positions and shifts of high members of the Cs principal series suggest that the positions of the high-intensity red satellite bands are determined primarily by the effective cross sections of foreign-gas molecules for slow electrons rather than by the mass or polarizability of these molecules as thought previously. (auth)

35732 ISOTOPIC SHIFTS IN SOME ULTRAVIOLET SYSTEMS OF N_2. P. K. Carroll (Univ. of Chicago). J. Chem. Phys., 39: 237-8(July 1, 1963).

The spectrum of N_2^{15} was investigated in the region 2000 to 9000 Å in order to study the vibrational structure of the weaker systems. Values for shifts in the levels r', s'h, d, and m as determined from the N_2^{15} spectrum are tabulated and discussed. (P.C.H.)

35733 VARIATION OF COLORATION RATES AND LUMINESCENCE IN HARSHAW POTASSIUM CHLORIDE. C. T. Butler, W. A. Sibley, and E. Sonder (Oak Ridge National Lab., Tenn.). J. Chem. Phys., 39: 242-3(July 1, 1963).

Variations in the coloring and luminescence properties of KCl crystals obtained from a single source were investigated. Flame photometry and infrared spectroscopy of the samples showed that the type and amount of impurities in the crystals are not functions of the time of purchase. In order to determine whether crystals from a single ingot vary, coloring curves were obtained for samples from different portions of ingots. In all cases the late stage coloring curve agreed to within about 20%. Luminescence spectra show variety both in the character of the emission spectra observed, as well as in the apparent intensities of the different bands. It was concluded that there is not yet available KCl stock that is sufficiently uniform in its composition to allow it to be used indiscriminately as a standard in the study of photoelectronic properties. (P.C.H.)

35734 RADIATIVE TRANSITION PROBABILITIES WITHIN $4f^n$ CONFIGURATIONS: THE FLUORESCENCE SPECTRUM OF EUROPIUM ETHYLSULFATE. John D. Axe, Jr. (International Business Machines Corp., Yorktown Heights, N. Y.). J. Chem. Phys., 39: 1154-60 (Sept. 1, 1963).

The relative intensities of the transitions occurring in the fluorescence spectrum of $Eu(C_2H_5SO_4)_3 \cdot 9H_2O$ were measured at 77 and 4°K. The strengths of both the "forbidden" electric dipole transitions and magnetic di-

pole transitions which were observed were compared to theoretical expressions and the results are discussed. The results are in reasonable agreement with recent phenomenological treatments of crystal-field-induced dipole radiation, and suggest that g-orbital configurational mixing contributes significantly to the process. (auth)

35735 FLUORIDE INTERFERENCE FILMS ON URANIUM DIOXIDE. I. THE KINETICALLY DERIVED OPTICAL EQUATION. W. P. Ellis (Los Alamos Scientific Lab., N. Mex.). J. Chem. Phys., 39: 1172-6(Sept. 1, 1963). (LADC-5685)

At the interfaces of absorbing dielectrics reflected light undergoes an abrupt phase change other than zero or π. For a transparent interference film on an absorbing dielectric substrate this change has the effect of shifting the wavelength of maximum interference toward a higher value. From the spectrophotometrically determined rates of film formation an extrapolation to zero time (zero thickness) gives the fractional wavelength shifts directly. Values were obtained experimentally for the hydrofluorination reaction of uranium dioxide and are compared with values calculated from optical theory. (auth)

35736 FLUORIDE INTERFERENCE FILMS ON URANIUM DIOXIDE. II. KINETICS OF THE HYDROFLUORINATION REACTION. W. P. Ellis and B. W. Roberts (Los Alamos Scientific Lab., N. Mex.). J. Chem. Phys., 39: 1176-81(Sept. 1, 1963). (LADC-5686)

In the temperature interval 200 to 300°C optically isotropic uniformly colored interference films are formed on the flat, polished surfaces of fused uranium dioxide by reaction with anhydrous gaseous hydrogen fluoride. The kinetics were determined spectrophotometrically at eight temperatures for film thicknesses up to $\frac{1}{4}$ micron. In the pressure interval 20 to 53 cm Hg, the rate of film growth is diffusion controlled with the thickness proportional to the square root of both pressure of HF(g) and time. The proportionality constant is $\beta = \beta_0 \exp(-Q/RT)$ Å/(sec × cm Hg)$^{1/2}$ in which $\beta_0 = 2.59 \times 10^3$ and $Q = 6930$ cal/mole with a 90% confidence interval of ±140 cal/mole. From metallographic examinations it was concluded that the uranium tetrafluoride product is deposited at the film–UO_2(s) interface. (auth)

35737 APPLICATION OF CONFIGURATION INTERACTION TO THE 2^3S STATE OF HELIUM. [PART] II. H. L. Davis (Sandia Corp., Albuquerque, N. Mex.). J. Chem. Phys., 39: 1183-6(Sept. 1, 1963). (TID-18471; SCDC-3149)

The configuration interaction method was applied to the nonrelativistic 2^3S state of the helium atom. It is shown, by variationally adjusting the effective charges of the angular configurations, that no radial readjustment occurs for this state. The final set of 80 configurations gives an energy of –2.1752259 amu, recovering 27% of the energy difference between the best previous configuration-interaction value and the extrapolated value of Pekeris. A discussion is presented concerning the relative merit of the configuration interaction method and suggestions given for its future application to the 2^3S state of the two-electron system. (auth)

35738 SHORT-DURATION VISIBLE AFTERGLOW IN HELIUM. Arthur L. Schmeltekopf, Jr. and H. P. Broida (National Bureau of Standards, Boulder, Colo.). J. Chem. Phys., 39: 1261-8(Sept. 1, 1963).

A bright, reproducible afterglow which consists of helium atomic and molecular emissions was observed in the flow products of an electrical discharge in a DeLaval nozzle clearly separated from the discharge. This afterglow was observed at pressures from 0.4 to 20 mm Hg and with flows from 10 to 1000 cm^3/sec NTP. At the low pressure the existence of the afterglow was extremely pressure sensitive to small changes in pressure. Metastable He-atom concentration decreased after the discharge and then increased in the region of afterglow emission. The afterglow was very sensitive to impurities greater than a few parts in 10^5 and emission intensity was reduced by the presence of an r-f field, possibly because heating the electrons retards recombination. (auth)

35739 MAGNETIC CHARACTERISTICS OF DYSPROSIUM, ERBIUM, AND THULIUM HYDRIDES. Yoshio Kubota and W. E. Wallace (Univ. of Pittsburgh). J. Chem. Phys., 39: 1285-8(Sept. 1, 1963).

Magnetization–temperature data are presented for the hydrides $DyH_{1.97}$ to $DyH_{2.97}$, $ErH_{1.96}$ to $ErH_{3.02}$, and $TmH_{1.99}$ to $TmH_{2.95}$ and for the three parent metals. Of the 15 hydrides examined only the Dy hydrides exhibited magnetic ordering. These hydrides showed a Néel point at nearly the same temperature as that found earlier for HoH_2, 8°K. The susceptibilities followed the Curie–Weiss law over most of the paramagnetic region with an effective moment nearly that of the free tripositive ion. Deviations from the Curie–Weiss law noted at low temperatures are attributed to crystal-field effects. The absence of magnetic ordering in the saturated hydrides is ascribed to the fact that these hydrides lack conduction electrons, which are essential for the magnetic coupling. (auth)

35740 ESR MEASUREMENT OF SPIN SUSCEPTIBILITY OF GRAPHITE IN A LOW MAGNETIC FIELD. R. C. Wayne and R. M. Cotts (Cornell Univ., Ithaca, N. Y.). J. Chem. Phys., 39: 1337-8(Sept. 1, 1963).

The spin susceptibility of pure crystals of natural graphite was measured by comparing the integrated intensity of the electron spin resonance signal to the intensity of the nuclear magnetic resonance of a known amount of aluminum powder mixed with the graphite sample. Both resonances were observed by using a crossed-coil nuclear induction probe at 12.8 Mc/sec. At 300°K, the spin susceptibility was found to be $(1.44 \pm 0.3) \times 10^{-6}$ cgs units per gram in agreement with known microwave measurements and theory. The apparent g value of low-field resonances observed with the crossed-coil probe is briefly discussed. (auth)

35741 COORDINATION NUMBERS OF BERYLLIUM AND ALUMINIUM IONS IN AQUEOUS SOLUTIONS. Robert E. Connick and Daniel N. Fiat (Univ. of California, Berkeley). J. Chem. Phys., 39: 1349-51(Sept. 1, 1963). (UCRL-10763)

It was previously shown that if cobaltous perchlorate is added to solutions of certain diamagnetic salts it is possible to distinguish separate O^{17} nuclear magnetic resonance (NPR) signals arising from the waters in the first coordination sphere of the diamagnetic ions and the free water, respectively. Coordination numbers of the ions could be obtained from the observed resonance for the bound water. The signal-to-noise ratio was increased by using water enriched to 11.43% in O^{17} and the sideband detection technique was employed instead of the usual derivative method. Studies were made for aluminum and beryllium ions. (M.C.G.)

35742 DIHALIDE IONS TRAPPED IN GLASSES. Tova Feldmann and Avner Treinin (Hebrew Univ., Jerusalem). J. Chem. Phys., 39: 1352-3(Sept. 1, 1963).

It was found that molten boric acid dissolves appreciable

concentrations of KBr and KI. Thin films of these glasses could be produced between quartz disks displaying distinct absorption bands due to the halide ion (X^-). The KBr and KI glasses were irradiated with a low-pressure mercury lamp. In both cases a new absorption band appeared, that was attributed to X_2^-. The trapped radicals showed marked stability at room temperature, but heating to about 100°C led to their fast annihilation. X_3^-, which was also produced by irradiation, seemed to require X_2^- for its formation. Increase of X_2^- concentration led to a decrease in its rate of formation. The fate of the photoejected electron was not determined. (M.C.G.)

35743 MOLAL VOLUMES AND ZERO-POINT ENERGIES OF THE ISOTOPIC LIQUID HYDROGENS. Jacob Bigeleisen (Eidgenossische Technische Hochschule, Zurich and Brookhaven National Lab., Upton, N. Y.). J. Chem. Phys., 39: 1356-7(Sept. 1, 1963). (BNL-6982)

The differences in "lattice" zero-point energies for the isotopic liquid hydrogens were evaluated from vapor-pressure and solution-equilibrium data. The molal volume differences could thus be correlated with the zero-point energy differences, if the latter were corrected for the thermal excitation of the phonons. (M.C.G.)

35744 PROTON NMR CHEMICAL SHIFTS OF HYDRONIUM AND HYDROXYL IONS. A. J. Kresge (Illinois Inst. of Tech., Chicago). J. Chem. Phys., 39: 1360-1 (Sept. 1, 1963). (TID-18621)

Nuclear magnetic resonance chemical shifts of hydronium and hydroxyl ions with respect to water were calculated. The shifts for both ions were downfield and of the order of 10 ppm. The effects of solvation shifts were investigated. (M.C.G.)

35745 DO THE "LIGAND FIELD" PARAMETERS IN LANTHANIDES REPRESENT WEAK COVALENT BONDING? Chr. Klixbuell Joergensen, Romano Pappalardo, and Hans-Herbert Schmidtke (Cyanamid European Research Inst., Geneva). J. Chem. Phys., 39: 1422-30(Sept. 15, 1963).

Instead of explaining the seven different f-orbital energies or five different d-orbital energies by parameters $A_m^n(\gamma^n)$ of the electrostatic ligand field model, it is proposed that the energy levels be classified according to the actual one-electron energies and that these quantities be interpreted by the weak effects of σ antibonding on the partly filled shell. Calculations of the relative angular dependence Ξ^2 of such effects were made in a simple model and compared with experimental data for nine- and eight-coordinated lanthanide compounds. The agreement is judged to be much more satisfactory than when the electrostatic model is applied, and the number of freely chosen parameters is much smaller. (auth)

35746 OBSERVATION OF FLUORESCENCE IN KETONE SOLUTIONS OF EUROPIUM AND TERBIUM SALTS. E. Matovich and C. K. Suzuki (Quantum Tech. Labs., Inc., Santa Ana, Calif.). J. Chem. Phys., 39: 1442-4(Sept. 15, 1963).

Relatively long-lived fluorescence was observed in simple ketone solutions of europium and terbium salts at room temperature without any deliberate formation of chelates or other complexes. Emission and absorption spectra of the solutions are presented, as well as the effects of dilution and water content on their fluorescent output. The temperature behavior of the fluorescent output and lifetime is also shown. (auth)

35747 EFFECTS OF ISOTOPIC LABELING AND MOLECULAR STRUCTURE ON PROBABILITY OF IONIZATION BY ELECTRON IMPACT. Seymour Meyerson, H. M. Grupp, and R. W. Vander Haar (American Oil Co., Whiting, Ind.). J. Chem. Phys., 39: 1445-6(Sept. 15, 1963).

Isotope effects are reported on probability of ionization of molecules by photons, by excited rare-gas atoms, and by beta rays. Such effects furnish evidence that ionization occurs largely as a secondary process in competition with nonionizing processes following primary excitation to an energy level above the ionization potential. Measurements of total ion current produced in a mass-spectrometer source show similar effects for the case of ionization by 70-ev electrons. Experimental support was obtained also for the corollary that probability of ionization depends upon molecular structure and is not simply, as was postulated, a constitutive property of the atoms. (auth)

35748 ANALYSIS OF THE ELECTRONIC SPECTRA OF NEODYMIUM ETHYLSULFATE. John B. Gruber and Robert A. Satten (Univ. of California, Los Angeles). J. Chem. Phys., 39: 1455-63(Sept. 15, 1963).

The polarized absorption spectra of single crystals of neodymium ethyl sulfate $[Nd(C_2H_5SO_4)_3 \cdot 9H_2O]$ were studied between 11,000 and 28,500 cm^{-1} at 77 and 4.2°K. From the 77°K polarized absorption spectrum of crystals of different thicknesses, it was possible to identify transitions from all the Stark components of the ground level $I_{9/2}^4$ to many of the Stark components of excited SLJ levels of the $4f^3$ configuration. The electronic transitions particularly of the $I_{9/2}^4$ ground level were reliably singled out from among vibronic transitions. The experimental assignment based on selection rules and the number of transitions observed was further verified by a comparison of the experimental levels with the "free-ion" spectrum predicted on the basis of the parameters $F_2 = 331.33$ cm^{-1}, $F_4 = 47.956$ cm^{-1}, $F_6 = 5.313$ cm^{-1}, and $\zeta = 880.11$ cm^{-1}. A first-order crystalline-field splitting calculation based on the parameters $B_2^0 = 58.4$ cm^{-1}, $B_4^0 = -68.2$ cm^{-1}, $B_6^0 = -42.7$ cm^{-1}, and $B_6^6 = 595$ cm^{-1} gives a predicted splitting to within a mean deviation of 4 cm^{-1}. (auth)

35749 MOLECULAR ORBITAL STUDIES OF EXCITED STATES OF HeH. H. H. Michels (United Aircraft Corp., East Hartford) and F. E. Harris. J. Chem. Phys., 39: 1464-9(Sept. 15, 1963).

The total energy of HeH was computed using a method of molecular orbital calculation in which the total wavefunction is taken as a linear combination of configurations, each a properly antisymmetrized product of flexible one-electron functions in an elliptic coordinate system. The lowest $^2\Pi$ state of this system and both of the $^2\Sigma$ excited states which arise from the interaction of ground-state He and a 2p or 2s H atom were examined. The lowest $^2\Pi$ state of HeH and the first excited $^2\Sigma$ state were found to be bonding with calculated dissociation energies of 1.935 and 2.336 ev, respectively. A comparison of these results with those previously reported for the ground state of HeH and the molecular ion HeH^+ indicated that the charge distribution about the helium atom is similar in all of these systems and it is predicted that, with the single exception of the ground state, all of the doublet states of HeH up to the ionization limit of the H atom are bonding and can be represented by very similar potential energy curves. (auth)

35750 ASSIGNMENT OF NMR SPECTRA WITH THE AID OF DOUBLE-QUANTUM TRANSITIONS. W. A. Anderson (Varian Associates, Palo Alto, Calif.), R. Freeman, and C. A. Reilly. J. Chem. Phys., 39: 1518-31(Sept. 15, 1963).

The analysis of complex nuclear magnetic resonance spectra usually requires the assignment of the observed

transition to an energy-level diagram. It is shown that double-quantum transitions can be used to determine such an assignment. Small frequency shifts of the double-quantum transitions were observed and their dependence upon the strength of the applied radio-frequency field measured and compared with theory. The double-quantum method is compared to the double resonance method in making an energy-level assignment using the 60-Mc/sec spectrum of trivinylphosphine for the purposes of illustration. The analysis was completed by an algebraic method and by iteration on a computer, and the results checked by recording the 100-Mc/sec proton spectrum and the 19-Mc/sec P^{31} spectrum. The three proton-proton couplings and the three P^{31} proton couplings all have the same sign. (auth)

35751 HIGH-TEMPERATURE HEAT CONTENT OF NIOBIUM CARBIDE AND OF TANTALUM CARBIDE. L. S. Levinson (Los Alamos Scientific Lab., N. Mex.). J. Chem. Phys., 39: 1550-1(Sept. 15, 1963). (LADC-5818)

The heat content of niobium carbide was measured between 1289 and 2778°K and that of tantalum carbide between 1296 and 2843°K using a drop calorimeter. (auth)

35752 CHEMICAL SHIFTS IN XENON FLUORIDES. D. Lazdins, C. W. Kern, and M. Karplus (Columbia Univ., New York). J. Chem. Phys., 39: 1611-12(Sept. 15, 1963).

The consistency of proposed bonding schemes with the chemical shifts observed in nuclear magnetic resonance studies of the XeF_n (N = 2,4,6) compounds was investigated. Equations were developed for calculating chemical shifts based on a molecular description of XeF_n compounds that postulates the formation of highly ionic bonds involving primarily the 2 p orbitals of fluorine and the 5 p orbitals of xenon. Comparison with experimental data showed that molecular mode is consistent with the main features of the observations. (M.C.G.)

35753 CALCULATIONS OF THE HYPERFINE SPLITTING FOR THE LITHIUM ATOM. J. B. Martin and A. W. Weiss (National Bureau of Standards, Washington, D. C.). J. Chem. Phys., 39: 1618-20(Sept. 15, 1963).

The hyperfine splitting of the ground state of lithium and its isoelectronic sequence was computed with configuration-interaction-type wavefunctions. The 35-configuration function was designed to represent only the correlation between the two K-shell electrons, which it appeared to do quite well, picking up 98.5% of the K-shell correlation energy. It is shown that a flexible 2s function, in conjunction with some K-shell correlation, is important. Intershell correlation effects were also noted. (M.C.G.)

35754 HOMONUCLEAR DECOUPLING: $P^{31}-P^{31}$. H. Agahigian, G. D. Vickers, J. Roscoe, and J. Bishop (Olin Mathieson Chemical Corp., New Haven). J. Chem. Phys., 39: 1621-2(Sept. 15, 1963).

Studies were made of phosphorus-phosphorus homonuclear decoupling. The P^{31} nuclear magnetic resonance spectra of phosphonitrile chloride consisted of two doublets, one at +12.7 ppm and the other at 1.1 ppm from external phosphoric acid. The phosphorus-phosphorus coupling was 19.5 cps. Irradiation of the low-field phosphorus caused the collapse of the high-field doublet into a single sharp line. The reverse effect was seen when the high-field multiplet was irradiated. The experiment was performed on a thioanalog of the compound and the results were equally successful. (M.C.G.)

35755 DECOMPOSITION OF Ce(IV) CHLORIDE COMPLEX: KINETIC STUDY IN PERCHLORIC ACID MEDIUM. Kalyan K. Sen Gupta, P. K. Pal, and S. P. Moulik (University Colleges of Science and Tech., Calcutta). J. Indian Chem. Soc., 40: 429-32(June 1963).

The red-colored complex formed by the interaction of ceric perchlorate and HCl in a high concentration of HCl is unstable and decomposes gradually. The kinetics of the decomposition obey first order law. The activation energy and the entropy of activation were found to be 6.3 kcals/mole and −38 (E.U.), respectively. (auth)

35756 ELECTRONIC ABSORPTION SPECTRA OF URANYL PHOSPHATE AND OXALATE. K. V. Narasimham (Andhra Univ., Waltair, India). J. Mol. Spectry., 11: 128-38(Aug. 1963).

The electronic absorption spectra of uranyl phosphate and uranyl oxalate were studied with powder samples of the compounds at liquid-air and liquid-nitrogen temperatures. About 75 bands in the case of the phosphate and 68 bands in the case of oxalate were obtained. The absorption bands of each compound were analyzed as due to three electronic transitions from a common ground state to the different excited states. The wave numbers of the fundamentals obtained from the electronic absorption were correlated with those obtained from fluorescence and infrared absorption. (auth)

35757 NUCLEAR MAGNETIC RESONANCE STUDY OF ION-EXCHANGE RESINS. I. HYDRATED DOWEX-50 RESINS. R. H. Dinius, M. T. Emerson, and G. R. Choppin (Florida State Univ., Tallahassee). J. Phys. Chem., 67: 1178-82(June 1963).

The proton magnetic resonance spectra for hydrated ion-exchange resin samples were measured. The effect on the chemical shift and line width was observed as a function of resin phase hydration, resin cross linkage, and temperature for Dowex-50. The effects are interpreted in terms of changes in water structure and rapid proton exchange in the resin phase. (auth)

35758 THE THERMODYNAMIC AND PHYSICAL PROPERTIES OF BERYLLIUM COMPOUNDS. III. HEAT OF FORMATION AND ENTROPY OF $BeF_2(g)$. Michael A. Greenbaum, M. Louis Arin, amd Milton Farber (Rocket Power, Inc., Pasadena, Calif.). J. Phys. Chem., 67: 1191-4(June 1963).

The reaction $BeO(s) + 2HF(g) \rightarrow BeF_2(g) + H_2O(g)$ was employed to yield values for ΔHf_{298} and S^0_{298} of $BeF_2(g)$. The experimentally determined values for ΔH_r and ΔS_r for the above reactions over the temperature range 943 to 1243°K are 20.5 ± 1.7 kcal and 6.0 ± 0.3 cal/deg/mole, respectively. From these values and available thermodynamic data on all the species of interest, the second-law values for ΔHf_{298} and S^0_{298} of $BeF_2(g)$ were found to be −191.3 ± 2.0 kcal/mole and 52.4 ± 0.3 cal/deg/mole, respectively. The third-law ΔHf_{298} for $Be_2(g)$ was determined to be −191.2 ± 0.4 kcal/mole. (auth)

35759 THE NEAR-INFRARED TRANSITIONS OF THE TRIVALENT LANTHANIDES IN SOLUTION. II. Tb^{+3}, Dy^{+3}, Ho^{+3}, Er^{+3}, Tm^{+3}, AND Yb^{+3}. W. T. Carnall (Argonne National Lab., Ill.). J. Phys. Chem., 67: 1206-11(June 1963). (TID-16900; UAC-6597)

The solution absorption spectra of Tb^{+3}, Dy^{+3}, Ho^{+3}, Er^{+3}, Tm^{+3}, and Yb^{+3} were measured in molten $LiNO_3$–KNO_3 eutectic at 150° in the 0.35 to 2.6 μ range and in $DClO_4$ at 23° in the 0.35 to 1.8 μ range. Observations of a number of absorption bands in solution in the region 1.40 to 2.6 μ (7140 to 3850 cm^{-1}) were made by taking advantage of the optical transparency of the $LiNO_3$–KNO_3 eutectic in this portion of the spectrum. Theoretical interpretations of the solution spectra are offered based on recent experi-

mental and theoretical analyses of crystalline salts of the lanthanide ions. (auth)

35760 THE EFFECT OF $LiClO_4$, LiCl, AND LiBr ON THE POLAROGRAPHIC BEHAVIOR AND ULTRAVIOLET SPECTRUM OF PRASEODYMIUM(III) IN ETHANOL. Sheldon H. Cohen, Reynold T. Iwamoto, and Jacob Kleinberg (Univ. of Kansas, Lawrence). J. Phys. Chem., 67: 1275-8(June 1963).

Polarographic and spectrophotometric studies of perchlorate-, bromide-, and chloride-containing ethanolic praseodymium(III) solutions, both in the absence and presence of added water, gave strong evidence that these anions and the tripositive lanthanide form ion-associates. These ion-associates are more readily reduced than the tripositive praseodymium ion solvated by ethanol or ethanol–water combinations. (auth)

35761 ELECTRON IMPACT INVESTIGATIONS OF SULFUR COMPOUNDS. III. 2-THIAPROPANE, 3-THIAPENTANE, AND 2,3,4-TRITHIAPENTANE. Brice G. Hobrock and Robert W. Kiser (Kansas State Univ., Manhattan). J. Phys. Chem., 67: 1283-6(June 1963).

In addition to reporting basic electron impact data for 2,3,4-trithiapentane, 2-thiapropane, and 3-thiapentane, comparisons of heats of formation of various series of related ions containing one, two, and three sulfur atoms were made. It was observed that, in general, successive addition of sulfur atoms has little effect on the heats of formation of the ions. This was also found to be true for variation of the R group. The addition of hydrogen atoms was observed, in almost all of the cases studied, to have a significant effect in decreasing the heats of formation of the ions. The heats of formation for the principal ions from the three compounds, in agreement with postulated processes, are given. The ionization potentials of the molecules are discussed as well as the derived values for the ionization potentials of C_2H_5SH and CH_3S_2H. (auth)

35762 CRYSTAL STRUCTURE OF ZIRCONYL PERCHLORATE DIHYDRATE BY X-RAY POWDER DIFFRACTION METHOD. P. Rama Murthy and C. C. Patel (Indian Inst. of Science, Bangalore, India). J. Phys. Chem., 67: 1357-8(June 1963).

X-ray diffraction patterns were determined for crystals of zirconyl perchlorate dihydrate, $ZrO(ClO_4)_2 \cdot 2H_2O$. The crystals were found to be biaxial in nature and the lines of the diffraction pattern were indexed for the orthorhombic system. The density of the crystals was calculated to be 1.912 g/ml. (M.C.G.)

35763 THE THIRD VIRIAL COEFFICIENT OF POTASSIUM AS ESTIMATED FROM ITS VAPOR PRESSURE. J. F. Walling (Battelle Memorial Inst., Columbus, Ohio). J. Phys. Chem., 67: 1380-2(June 1963).

Vapor-pressure data for potassium that show the effect of trimers are presented. The vapor pressure of carefully purified potassium was determined in a modified boiling point experiment. An apparent third law heat of sublimation was calculated from each datum by using published free energy functions and second virial coefficients. Results are shown in graph form. A correction function ascribed solely to third virial effects was constructed. The credibility of the vapor pressure data and interpretation of the correction is demonstrated. (M.C.G.)

35764 A TRANSPIRATION STUDY OF LITHIUM HYDROXIDE. Joan B. Berkowitz-Mattuck and Alfred Buechler (Arthur D. Little, Inc., Cambridge, Mass.). J. Phys. Chem., 67: 1386-8(June 1963).

Studies of the $Li_2O–H_2O$ system were extended by use of the transpiration method to water vapor pressures beyond the range accessible to mass-spectrometric work. The measurements were made at temperatures of 1095 and 1145°K and water vapor pressures of 4.58 and 19.5 mm. The reaction rate was a limiting factor at moderate flow rates and observed weight losses depended on the surface area of the sample. (M.C.G.)

35765 PROCEEDINGS OF THE INTERNATIONAL CONFERENCE ON CRYSTAL LATTICE DEFECTS, SYMPOSIUM, TOKYO, SEPTEMBER 3-4, 1962. J. Phys. Soc. Japan, 18: Suppl. I, 1-199(Mar. 1963).

Proceedings of the Tokyo Symposium of the International Conference on Crystal Lattice Defects are presented. Thirty-four papers on motions of dislocations in crystals, work hardening, internal friction as interaction between dislocations and point defects, and problems relating to the Bordoni Peak. Separate abstracts were prepared for 5 papers. Three papers were previously abstracted for NSA. (M.C.G.)

35766 THE HARDENING OF ALKALI-HALIDE CRYSTALS BY POINT DEFECTS. W. G. Johnston, J. S. Nadeau, and R. L. Fleischer (General Electric Research Lab., Schenectady, N. Y.). J. Phys. Soc. Japan, 18: Suppl. I, 7-15(Mar. 1963).

The hardening of alkali-halide crystals by divalent impurities and by radiation-produced defects was studied in the temperature range of 20.5 to 300°K. The amount of hardening produced by small concentrations of divalent metal impurities, and the temperature dependence of the hardening depended sensitively on the state of dispersion of the impurities. At 20.5°K the greatest hardening was produced by divalent ion-vacancy pairs. At 300°K the greatest hardening was produced by impurity clusters in extremely slowly cooled crystals. From mechanical tests and optical studies of irradiated crystals it was deduced that the severe hardening produced at room temperature by x rays and γ rays is due to the interstitial halogen ions that are formed when F-center vacancies are created. The V_K-center (self-trapped hole) that is produced during irradiation at 77°K is also very effective in hardening LiF. The behavior of alkali halide crystals is compared with that of other materials in which severe hardening is produced by small concentrations of defects. The principal correlation is that all defects which produce severe hardening have non-symmetrical strain fields associated with them. The manner in which the non-symmetrical, or tetragonal strain can produce the great hardening is discussed. (auth)

35767 TRANSMISSION ELECTRON MICROSCOPY, SLIP-LINES, AND WORK-HARDENING OF F.C.C. SINGLE CRYSTALS. A. Seeger (Technische Hochschule, Stuttgart). J. Phys. Soc. Japan, 18: Suppl. I, 59-68(Mar. 1963).

Work on the plastic deformation of fcc single crystals (in particular flow stress measurements, stored energy, slip lines, and transmission electron microscopy) is discussed in the light of the theory of work-hardening. It is shown that the results fit the long-range stress theory of work-hardening quite well. By creep experiments on copper single crystals the various contributions to the flow stress (long-range stresses, thermally activated forest contributions, and elastic interaction with dislocation forest) were obtained. It is shown that the dominant contribution to the hardening rate is due to long-range stresses and not to the dislocation forest. Observations are presented demonstrating that the slip-line pattern on the crystal surface is equivalent to a cross section through the interior of the crystals and, therefore, give reliable infor-

mation on the bulk processes. Transmission electron micrographs were obtained showing the dislocation arrangement in the principal glide plane of deformed fcc single crystals. The pattern was similar to what was predicted by the theory, and quite different from the tangled dislocation arrangement emphasized in literature. The main objections that were raised against the work-hardening theory based on long-range stresses are briefly discussed. It is shown that all of them can be met. (auth)

35768 ANOMALOUS ULTRASONIC VELOCITY CHANGES IN DEFORMATION AND IRRADIATION INDUCED DISLOCATION PINNING. R. Truell and A. Granato (Brown Univ., Providence). J. Phys. Soc. Japan, 18: Suppl. I, 95-101(Mar. 1963).

The effect of dislocation pinning is usually that of reducing the damping and increasing the velocity (or modulus) for ultrasonic waves. However, dislocation theory predicts that at high enough frequencies (or at large loop lengths or high phonon densities), an anomalous effect can occur. That is, the ultrasonic velocity can decrease with pinning. This effect is discussed and examples are shown for slightly deformed pure aluminum and sodium chloride single crystals. (auth)

35769 ULTRASONIC ATTENUATION AND SOME RELATED BEHAVIORS IN IRRADIATED ALKALI HALIDE CRYSTALS. Touichi Okada and Tokuo Suita (Osaka Univ.). J. Phys. Soc. Japan, 18: Suppl. I, 135-41(Mar. 1963).

Sodium chloride crystals subjected to gamma irradiation from zero to about 10^7 r in total dose at room temperature were examined during deformation by the following experimental techniques: observation of the yield point on the stress-strain relationships, observation of the ultrasonic attenuation changes as a function of the load, and observation of birefringence band. The yield stress of irradiated sodium chloride crystal in general increased with gamma dose for the following pretreated specimens: as annealed in air, after plastic deformation of about two per cent, about two per cent deformation and then annealed in air. The yield stress vs irradiation dose curve of the crystals annealed in air had a maximum at the total dose of about 1.5×10^5 r and a minimum at about 10^6 r. The stress-strain relationships and the attenuation change vs stress when the specimen was under load were similar for the early stages of plastic flow in annealed crystal, namely, near the stress where macroscopic yielding occurred, appreciable increases in the damping were observed; with further deformation the damping saturates at a certain value. The higher the irradiation dose, the smaller these saturation values were found to be. For irradiated crystals attenuation decreased by a small amount just above the yield stress notwithstanding the onset of plastic deformation, and increased with increasing load. Birefringence due to dislocations in glide bands of sodium chloride crystals clearly showed the initiation of the plastic flow in an unirradiated crystal as well as irradiated. A tentative model is proposed to explain the experimental results. (auth)

35770 INTERSTITIAL-DISLOCATION INTERACTION IN NIOBIUM. D. H. Boone and C. A. Wert (Univ. of Illinois, Urbana). J. Phys. Soc. Japan, 18: Suppl. I, 141-8(Mar. 1963).

Interstitial-dislocation interactions in niobium were investigated using the cold-work and Snoek internal friction peaks. Both the temperature of the cold-work peak and its height were found to depend on the amount of nitrogen removed from solution by dislocations in deformed specimens. Interstitial oxygen had only a minor effect and deformations beyond 5% were found to change the peak very little. The characteristics of the peak can be related to the interstitial content of the dislocation atmosphere and understood if these interstitials are assumed to interact to form clusters. These interstitial clusters relax in some cooperative manner which results in an order-of-magnitude increase in the relaxation strength per atom. (auth)

35771 PROCEEDINGS OF THE INTERNATIONAL CONFERENCE ON CRYSTAL LATTICE DEFECTS, CONFERENCE, KYOTO-1, SEPTEMBER 7-12, 1962. J. Phys. Soc. Japan, 18: Suppl. II, 1-356(Mar. 1963).

Seventy-one papers presented at the International Conference on Crystal Lattice Defects in Division I of the Kyoto Conference are given. Topics covered include: magnetic resonance and optical studies of lattice defects; electrons and phonons in imperfect lattices; scattering of electrons and phonons by lattice defects; equilibrium among defects in compounds; impurity conduction and energy levels of defects in semiconductors; formation and migration of point defects; color centers and luminescence; and observations of lattice defects. Separate abstracts were prepared for 26 papers. Six papers were previously abstracted for NSA. (M.C.G.)

35772 FIELD ION MICROSCOPY OF THE DEFECT STRUCTURE OF METAL CRYSTALS. Erwin W. Mueller (Pennsylvania State Univ., University Park). J. Phys. Soc. Japan, 18: Suppl. II, 1-17(Mar. 1963).

Principles and designs of the field ion microscope are reviewed. Uses in studying such crystal imperfections as impurities, vacancies, interstitials, dislocations, and grain boundaries are discussed. Possibilities of its use in research on solute and ordered alloys are also considered. The use of motion picture film with the field ion microscope is described. (M.C.G.)

35773 THE STUDY OF CRYSTAL IMPERFECTIONS IN THERMAL CONDUCTIVITY MEASUREMENTS. K. Mendelssohn (Oxford Univ.). J. Phys. Soc. Japan, 18: Suppl. II, 17-21(Mar. 1963).

The use of thermal conductivity measurements for the detection of lattice imperfections is assessed. The phenomena to be expected when no lattice defects are present were examined. The case of the dielectric crystal was considered first. It is shown that the thermal conductivity of an ideally pure dielectric crystal rises with falling temperature and, after passing a maximum, drops to zero at $T = 0$. Any extra scattering produced by lattice defects reduces the heat conduction of the sample and the magnitude, as well as the temperature dependence, of this reduction provides the basis for the analysis of the number and nature of the defects. For pure metals, the thermal conductivity curve, which from absolute zero, rises at first linearly, passes through a maximum, and then falls off again at higher temperatures, according to the equation: $W = 1/K = \alpha T^2 + \beta/T$, where β is a measure of impurity content and essentially due to collisions with point imperfections. The thermal conductivity of metals which become superconductive was also considered. (M.C.G.)

35774 AN EPR STUDY OF THE LATTICE VACANCY IN SILICON. G. D. Watkins (General Electric Research Lab., Schenectady, N. Y.). J. Phys. Soc. Japan, 18: Suppl. II, 22-7(Mar. 1963).

An EPR (electron paramagnetic resonance) spectrum was observed in silicon which was identified as arising from the isolated lattice vacancy. It was observed in p-type silicon which was irradiated in situ at ~40°K by 1.5-Mev electrons. A simple molecular orbital treatment of the vacancy is out-

lined which describes many of the features of the spectrum and predicts the observed anisotropy as resulting from a Jahn-Teller distortion. Studies of the disappearance of the vacancy vs anneal are described and interpreted in terms of long range migration of the vacancy and subsequent trapping by other defects. The activation energy for vacancy motion was determined to be 0.33 ± .03 ev in p-type material. Further study is required in n-type silicon before an unambiguous interpretation of the emergence of vacancy-impurity pairs can be made. (auth)

35775 INFRARED ABSORPTION SPECTRA OF DEFECTS IN IRRADIATED SILICON. A. K. Ramdas and H. Y. Fan (Purdue Univ., Lafayette, Ind.). J. Phys. Soc. Japan, 18: Suppl. II, 33-6(Mar. 1963).

Vibrational absorption bands produced in silicon by neutron irradiation and by electron irradiation were studied. The absorption centers involved oxygen atoms in the material. With electron irradiation the production rate of the 11.98-micron band at 80°K was not significantly different from that at 300°K. The result indicated that vacancies are mobile at 80°K with an activation energy for diffusion <0.24 ev. In contrast to the 11.98-micron band, another band at 11.56 microns did not appear under electron irradiation at 80°K but showed up after the sample was warmed to room temperature. Both absorption bands saturated with neutron as well as electron irradiation. Annealing above 473°K produced additional absorption bands in the vicinity of the 11.98-micron band in neutron-irradiated samples but not in electron-irradiated samples. The additional bands were produced while the 11.98- and the 11.56-micron bands remained unchanged. It is suggested that the centers of the additional bands consist of oxygen atom and defect aggregates. (auth)

35776 MÖSSBAUER EFFECT IN RELATION TO LATTICE DEFECTS. U. Gonser and H. Wiedersich (Atomics International, Canoga Park, Calif.). J. Phys. Soc. Japan, 18: Suppl. II, 47-54(Mar. 1963).

The influences of lattice defects associated with Mössbauer atoms on the Mössbauer emission and absorption spectrum are discussed. Some cases are indicated where information about lattice defects can be obtained with the help of the Mössbauer effect. Two types of defects are distinguished: defects resulting from the decay of the parent isotope to the excited state from which the low-energy γ-ray is emitted and defects whose association with Mössbauer atoms can be influenced by outside means. Preliminary results are given for the precipitation processes in an iron-supersaturated Cu–Fe solution using the Mössbauer effect as a tool. (auth)

35777 VALENCE AND SIZE CONTRIBUTIONS TO ELECTRIC FIELD GRADIENTS IN DILUTE ALLOYS OF SILVER. Gilbert R. Hoy, George W. Hinman, and Joseph K. Lees (Carnegie Inst. of Tech., Pittsburgh). J. Phys. Soc. Japan, 18: Suppl. II, 54-6(Mar. 1963).

A series of measurements was carried out on alloys of silver to study the electric field gradients produced near solute sites by conduction electron rearrangement (valence effect) and lattice distortion (size effect). The field gradients were measured by observing the attenuation of the angular correlation of cascade gamma rays emitted by Cd^{111} nuclei in the alloys. The conclusions of the work are that both valence and size effects are important in determining the field gradients, that the valence effect is longer range than Thomas-Fermi screening predicts, and that the results are best explained by assuming that the lattice distortion is not spherically symmetric. (auth)

35778 LOCALIZED LATTICE VIBRATIONS. [PART] II. J. A. Krumhansl (Cornell Univ., Ithaca, N. Y.). J. Phys. Soc. Japan, 18: Suppl. II, 70-5(Mar. 1963).

The results of an "effective elastic continuum" method used to calculate the affect of imperfections on the lattice vibration spectrum are presented. The method is, on the one hand, analogous to those employed to describe localized electronic states in semiconductors, and on the other hand, similar to continuum elasticity theory of static point defects. Exact and approximate calculation can be compared for a one dimensional model with either mass or potential perturbations. For example: a mass defect of 25% yields a frequency perturbation $(\omega^2/\omega_m^2 - 1) = 0.0625$ and a damping factor of 0.6 per lattice constant for the localized displacement field, in the exact calculation; the approximate method yields 0.066 and 0.58, respectively, for the same parameters. For three dimensional lattices, in analogy to continuum elasticity theory, the localized modes are similar to vector spherical elastic waves. One important feature is characteristic of three dimensional lattices, localized modes need not exist if the perturbations are sufficiently weak. (auth)

35779 SCATTERING OF PHONONS BY LATTICE DEFECTS. R. L. Sproull and R. O. Pohl (Cornell Univ., Ithaca, N. Y.). J. Phys. Soc. Japan, 18: Suppl. II, 89-92(Mar. 1963).

Phonon scattering by lattice defects in non-metals is being studied by measuring the thermal conductivity over a wide temperature range of crystals containing known concentrations of known types of defects. The relaxation times, τ, for different types of defects depend differently upon the phonon frequency, and types of defects can thus be distinguished by differences in the temperature dependence of the thermal conductivity. Experiments on phonon scattering by isotopes, F-centers, dislocations, chemical impurities, and colloids are discussed. (auth)

35780 THE DEFECT STRUCTURE OF CUPROUS OXIDE. Michael O'Keeffe, Yukiko Ebisuzaki, and Walter J. Moore (Indiana Univ., Bloomington). J. Phys. Soc. Japan, 18: Suppl. II, 131-6(Mar. 1963).

Measurements were made of the Hall effect in single crystals of cuprous oxide below 200°C. In this range the hole mobility is given by $\mu = 3.1 \times 10^5\ T^{-\frac{1}{2}}$. The number of frozen-in acceptors is much less than the number of cation vacancies. It is suggested that vacancies with their associated positive holes pair on cooling to form a complex electronically analogous to H_2. This model is in accord with magnetic measurements. At high temperatures the paired holes are dissociated; the high density of acceptors results in a merging of the acceptor levels with the valence band. In accord with this model it is shown that the number of free holes varies as the $\frac{1}{4}$ power of oxygen pressure at high temperatures. Infrared absorption bands previously ascribed to defects are shown to arise from lattice vibrations. Diffusion measurements indicate that a very small fraction of the excess oxygen occurs as interstitial atoms. (auth)

35781 VACANCY INTERACTION ENERGIES IN TRANSITION METAL OXIDES. Michael Hoch (Univ. of Cincinnati). J. Phys. Soc. Japan, 18: Suppl. II, 147-51(Mar. 1963).

Vacancy interaction energies E_{11} and E_{22} (for vacancies with same sign) and E_{12} (with opposite sign) in transition metal oxides of the NaCl-type structure were determined by studying the variations of the partial free energy of oxygen with composition. In MnO, E_{22} = 1.34 ev; in FeO,

E_{22} = 0.120 ev; in CoO, E_{22} = 2.08 ev; in TiO, $E_{11} = E_{22}$ = 0.100 ev, E_{12} = −0.140 ev; in VO, $E_{11} = E_{22}$ = 0.202 ev, E_{12} = −0.286 ev; and in NbO, $E_{11} = E_{22}$ = 0.780 ev, E_{12} = −1.10 ev. An attempt was also made to calculate the vacancy interaction energies using the Debye-Hückel theory of strong electrolytes to account for the long-range coulombic interaction. This method gave good results for NaCl and KCl, but failed for the transition metal oxides. A qualitative relationship was derived showing that the logarithm of the vacancy interaction energies should depend on E° the potential for the following reaction: $(Metal)^{2+} \rightarrow (Metal)^{3+} + \theta$. (auth)

35782 PROPERTIES OF VACANCIES IN THE NOBLE METALS. R. O. Simmons (Univ. of Illinois, Urbana). J. Phys. Soc. Japan, 18: Suppl. II, 172-8(Mar. 1963).

A summary of the results of direct measurements of equilibrium concentrations of vacancies in copper, silver, and gold provides the basis for critical comparison with the results of recent quenching-annealing experiments on copper, quantitative evaluation of the expected magnitudes of several physical property changes due to equilibrium vacancies, identification of monovacancies as the predominant defects responsible for self-diffusion in these metals and approximate evaluation of the relative importance of divacancies in the process, and relation of vacancy concentrations in the solid phase to relative volume changes upon melting. The value of direct vacancy concentration measurements is emphasized as a contribution toward the eventual atomic interpretation of the thermal annealing processes occurring in quenched, in irradiated, and in cold-worked metals. (auth)

35783 CONCENTRATION DEPENDENCE OF ZENER RELAXATION IN SILVER–GOLD SOLID SOLUTIONS. Thomas J. Turner and George P. Williams, Jr. (Wake Forest Coll., Winston-Salem, N. C.). J. Phys. Soc. Japan, 18: Suppl. II, 218-23(Mar. 1963).

Zener relaxation studies were performed with an inverted torsion pendulum on silver-gold solid solutions with concentrations ranging from 25 to 80 at. % gold. Arrhenius plots obtained from curves of ln τ_r vs concentration yielded activation energies ranging from 42 to 39.5 kcal/mole extrapolated across the composition range from pure silver to pure gold. The intercepts, $\log_{10} \tau_{r_0}$, ranged from −14.2 to −14.7 indicating that the entropy changes by approximately +2 units of R in contradistinction to results from diffusion studies in which the entropy is by −2 units of R. Within the accuracy of the activation energy determinations the peak widths agree with those of a single relaxation process. (auth)

35784 HIGH PRESSURE STUDIES OF POINT DEFECTS. David Lazarus (Univ. of Illinois, Urbana). J. Phys. Soc. Japan, 18: Suppl. II, 224-8(Mar. 1963).

Studies of the rate of formation and motion of point defects as a function of external hydrostatic pressure permit, within the framework of reaction-rate theory, determination of the volume changes associated with the basic processes. Experimental arrangements were developed for such studies. Measurements of the formation and motion of vacancies, interstitials, and color centers in a number of metals and ionic crystals indicated considerable relaxation about the point defects, generally more than predicted by many current theoretical models. (auth)

35785 EFFECT OF HYDROSTATIC PRESSURE ON THE RATE OF ATOMIC MOVEMENT IN NOBLE METALS. C. T. Tomizuka (Univ. of Arizona, Tucson). J. Phys. Soc. Japan, 18: Suppl. II, 228-9(Mar. 1963).

High-pressure studies of vacancies in noble metals are being carried out. (M.C.G.)

35786 THEORY OF VACANCY FORMATION IN INTERNALLY STRESSED CRYSTALS UNDER PRESSURE. L. A. Girifalco and D. Kuhlmann-Wilsdorf (Univ. of Pennsylvania, Philadelphia). J. Phys. Soc. Japan, 18: Suppl. II, 230-3(Mar. 1963).

The equilibrium vacancy concentration in crystals, subject to hydrostatic pressures, or internal stress systems, or both, was calculated. The dependence of vacancy concentration on stresses was due to four major effects. Work done by or against the externally applied hydrostatic pressure is one effect, as the volume of a crystal increases when an atom is removed from its interior to form a vacancy, and is redeposited on the crystal surface. The change in elastic energy of a stressed crystal is another because the vacancy with its immediate vicinity constitutes an elastically "soft" region. Work done by or against the normal stress components of the internal stress system as the material around the vacancy relaxes by V_R, the volume of relaxation, is a third effect. The change of localized modes of lattice vibrations, reacting to the strains in the vicinity of the vacancy, is the fourth effect. In addition, the zero point energy of the local modes is changed by strains, and an electrical interaction exists so as to attract vacancies to regions of compression. However, the latter two terms are negligible. A theoretical formula was derived to take account of the named major effects, and was applied to dislocations in otherwise stress free isotropic crystals. It was found that in fcc metals at high temperatures the frequency effect is dominant, causing vacancies to be repelled from regions of compression. A logical consequence of these results is that edge and mixed dislocations cannot climb readily, even though attracting vacancies. Some rather puzzling previous experimental observations may be explained on the basis of this result. (auth)

35787 FORMATION AND OPTICAL BLEACHING OF F CENTERS: IMPURITY EFFECTS. Fumio Okamoto and Allen B. Scott (Oregon State Univ., Corvallis). J. Phys. Soc. Japan, 18: Suppl. II, 243-9(Mar. 1963).

The x-ray darkenability and optical bleaching rate for F centers were measured at room temperature for KCl crystals grown from aqueous solution, and the results compared with crystals of varying purity and method of preparation. The initial rates of formation and bleaching of F centers were lowest for pure KCl grown from solution, highest for melt-grown crystals containing $CaCl_2$, and intermediate for Harshaw crystals. Unfiltered x rays were used. As with hard x rays, F-center growth consists of two stages; however, with solution-grown crystals the second stage only develops clearly on re-x-irradiation after bleaching and the first stage follows a rate equation second order in the vacancy concentration. One stage is found sufficient to account for optical bleaching. On re-x-irradiation after bleaching, the same first-stage rate equation is followed. F centers are rapidly formed and the secondary centers are destroyed. The rate depends principally on the concentration of F centers destroyed by the previous bleaching. (auth)

35788 α CENTERS IN ALKALI HALIDE CRYSTALS. Ryumyo Onaka, Ikuo Fujita, and Atsuo Fukuda (Tokyo Univ. of Education). J. Phys. Soc. Japan, 18: Suppl. II, 263-8 (Mar. 1963).

Optical studies were made concerning α centers in KI, KBr, KCl, NaCl, and NaF. Position, half width, and oscillator strength of α absorption bands, thermal stability of α

centers, and fluorescence by α light absorption and its quantum efficiency were investigated. The observed fluorescence suffered quite a large Stokes shift in all the crystals measured. The quantum efficiency of α fluorescence was determined on KCl by referring to that of 305 mμ emission excited by 246 mμ band in KCl:Tl phosphor. Temperature dependence of the emission spectrum of α fluorescence was found not remarkable and the quantum efficiency seemed to be independent of method of coloration and concentration of α and F centers. (auth)

35789 INTERACTION OF LOW ENERGY ELECTRONS WITH INSULATING CRYSTALS. W. J. Fredericks and C. J. Cook (Stanford Research Inst., Menlo Park, Calif.). J. Phys. Soc. Japan, 18: Suppl. II, 281-5(Mar. 1963).

The absorption coefficients for slow electrons on sodium chloride were measured. Techniques developed for these measurements utilizing 0.2 to 12 ev beams with a dispersion of 0.2 ev and currents less than 2×10^{-14} amperes are outlined. The data showed that strong electron-crystal interactions occur at impacting energies equivalent to F and V_3 center optical absorption bands. With these centers to orient the energy scale, the onset of secondary emission provides an estimate of the energy required for a band to band transition. The NaCl data are similar to and compared with previous measurements on KCl, KCl:K, and KBr:K. The divergency between the band gap energy E_g in NaCl as measured by various techniques was considered and it was concluded that the most probable value for E_g is 9.6 ± 0.2 ev. (auth)

35790 THERMAL GLOW LUMINESCENCE IN PLASTICALLY DEFORMED KCl CRYSTAL. M. Ueta, H. Sugimoto, and I. Nagasawa (Tohoku Univ., Sendai). J. Phys. Soc. Japan, 18: Suppl. II, 286-8(Mar. 1963).

It was found that plastically deformed KCl crystals show simple glow luminescence irrespective of x-ray or exciton-light irradiation. The glow was attributed to the recombination of electrons and holes trapped by single vacancies and vacancy clusters. An intensity of 250°C maximum was found to increase as the square of exciton density. From this, the exciton effect in deformed crystal is discussed. (auth)

35791 STUDIES OF POINT DEFECTS IN MAGNESIUM OXIDE. John E. Wertz, G. Saville, P. Auzins, and J. W. Orton (Univ. of Minnesota, Minneapolis). J. Phys. Soc. Japan, 18: Suppl. II, 305-11(Mar. 1963).

An attempt was made to correlate optical absorption bands in single magnesium oxide crystals with point defects known to exist from electron spin resonance observations. Optical measurements in the range of 4000 to 50000 cm^{-1} were made on crystals as received, after heat treatments, after ultraviolet or x-irradiation, and after neutron irradiation, with subsequent heat treatment or irradiation. The goal was the assignment of optical bands as due to impurities in particular valence states, to trapped hole centers, or trapped electron centers. Some progress was made by comparison of optical and ESR spectra on the same crystals. The point defect for which the correlation of behavior of the two types of spectra was best was the single hole trapped on an oxygen ion adjacent to a positive ion vacancy. The absorption band which is ascribed to this center occurs at 18500 cm^{-1}, and is responsible for the fleeting violet color of MgO crystals upon irradiation. While neutron irradiation gives rise to F-centers (electrons trapped at negative ion vacancies) and to visible coloration, no assignment of optical bands with particular electron trapping centers was made. (auth)

35792 MAGNETIC RESONANCE IN IRRADIATED ZIRCON. On Matumura and Hiroshi Koga (Kyushu Univ., Fukuoka, Japan). J. Phys. Soc. Japan, 18: Suppl. II, 312-14(Mar. 1963).

Electron spin resonance was observed in colored zircon. The pattern was anisotropic with respect to the field orientation, and could be fitted with electronic spin S = 1, g = 2.018, and $|D| = 10 \times 10^{-4}$ cm^{-1}. As a model for this magnetic center, Zr^{2+} adjacent to an oxygen vacancy was proposed. In zircon heated to 700°C in air, a very broad resonance absorption was found. The magnetization measurements were carried out, and the results show that it has ferromagnetic properties. (auth)

35793 THERMOLUMINESCENCE OF γ-IRRADIATED RUBY. T. Maruyama (NAIG Nuclear Research Lab., Kawasaki, Japan), Y. Matsuda, H. Kon, and H. Yonemitsu. J. Phys. Soc. Japan, 18: Suppl. II, 315-20(Mar. 1963).

The radiation damages to rubies by gamma rays were studied mainly in regard to its optical properties. By γ-irradiation, some color centers are produced in rubies. The damage center has an optical absorption band with its peak at 465 mμ and is annealed by heating with emission of thermoluminescence. The thermoluminescence occurs in approximately three successive stages, each with its characteristic activation energy. The values of these three activation energies were: $E_1 = 0.81 \sim 0.85$ ev, $E_2 = 0.93 \sim 0.94$ ev, and $E_3 = 1.06 \sim 1.16$ ev. The wave lengths of the thermoluminescence were $640 \sim 680$ μm and $610 \sim 650$ mμ corresponding to E_1 and E_3 respectively. The one corresponding to E_2 was not observed successfully. The intensity of thermoluminescence increased with γ dose and came to plateau near the point of 7×10^4 roentgen, after which it decreased with the concentration of chromium ion. The maximum intensity was observed in the crystal with nominal Cr_2O_3 concentration of 0.10%. It seemed that, in the mechanism of thermoluminescence in ruby, the initial imperfection of the crystal plays an important role. (auth)

35794 THE APPLICATION OF FIELD ION MICROSCOPY TO THE STUDY OF LATTICE DEFECTS. D. G. Brandon, M. Wald, M. J. Southon, and B. Ralph (Cambridge Univ., Eng.). J. Phys. Soc. Japan, 18: Suppl. II, 324-32 (Mar. 1963).

The conditions for obtaining a stable image in the field ion microscope and the limitations arising from the mechanism of image formation are outlined, and the use of the technique for the study of lattice defects is described. The field ion microscope can reveal individual vacancies and vacancy clusters produced by high energy recoils during irradiation. By bombarding with low energy particles the threshold energy for displacement and the energy transfer processes can be studied. The atomic structure of grain boundaries can be observed and related to existing theories of grain boundaries. Good images can be obtained from many alloys and information on the structure of solid solutions and precipitate phases can be obtained. (auth)

35795 RECENT STUDIES OF LATTICE DEFECTS BY X-RAY DIFFRACTION TOPOGRAPHY. A. R. Lang (H. H. Wills Physics Lab., Royal Fort, Bristol, Eng.). J. Phys. Soc. Japan, 18: Suppl. II, 332-5(Mar. 1963).

The usefulness of x-ray diffraction topography in studying lattice defects is discussed. Uses in investigations of dislocations, precipitates, inclusions, impurities, radiation damage, and magnetic domain are described. (M.C.G.)

35796 THE EFFECTS OF ION BOMBARDMENT ON MOLYBDENITE AND GRAPHITE. Kazuhiro Mihama (Nagoya Univ., Japan). J. Phys. Soc. Japan, 18: Suppl. II, 352-6(Mar. 1963).

The effects of ion bombardment on the specimens of layer structure such as molybdenite and graphite were studied by means of transmission electron microscopy. The ion bombardment was performed by the use of ion gun with air or argon, operated under the accelerating voltage of 5 to 10 kv. The effects of the ion bombardment observed in electron micrographs can be classified as follows: appearance of pair of "black and white spots," appearance of "pair of loops" developed from the pair of spots, and pinning up or tangling of dislocation lines at the positions of pair of spots or pair of loops. These productions may be due to the aggregation of point defects created by the impact of ion beam to the constituent atoms. (auth)

35797 STUDIES ON COORDINATION COMPOUNDS OF URANYL ACETATE WITH ORGANIC ACIDS. III. THE SYSTEM: URANYL ACETATE–BENZILIC ACID–WATER. C. S. Pande and S. K. Misra (Lucknow Univ., India). [J. Prakt. Chem., 19: 330-6(Mar. 1963)].

Conductometric and pH studies of the mixed solutions of uranyl acetate and sodium benzilate revealed the existence of one complex compound in (1 : 2) molecular ratio. The compound was isolated and its U-content determined. (auth)

35798 EFFECTS OF VARIOUS ADMIXTURES OF Li AND Ga ON CATALYTIC PROPERTIES OF ZnO IN RELATION TO THE HOMOMOLECULAR EXCHANGE OF OXYGEN ISOTOPES. V. I. Gorgoraki, L. A. Kasatkina, and V. Yu. Levin (Inst. of Chemistry and Tech., Moscow). Kinetika i Kataliz, 4: 422-30(May-June 1963). (In Russian)

Homomolecular isotopic exchange of $O_2^{16} + O_2^{18} = 2O^{16}O^{18}$ on pure ZnO and ZnO with various admixtures of Li and Ga was studied at 425 to 550°C and oxygen pressure of 5 to 200 mm Hg. The activation energy was ~40 kcal/mole. On the basis of the data it was assumed that sorption of molecular oxygen with dissociation on atoms is the limiting point of homomolecular exchange. Effects of admixtures and physical and catalytic properties of ZnO were correlated and analyzed. (tr-auth)

35799 PERMEABILITY OF URANYL IONS ACROSS ION EXCHANGE MEMBRANES. Ichiro Kamii (Showa Coll. of Pharmacy, Tokyo). Kogyo Kagaku Zasshi, 65: 1234-7 (Aug. 1962). (In Japanese)

The permeability of uranyl ions across heterogeneous ion exchange membranes was examined by electrodialysis using a 5-compartment cell. The membranes were formed with Amberlite resins (IR-4B, IR-120, IRA-400, IRC-50). Considerable quantities of uranyl ions permeated both the cation and the anion exchange membranes, showing the coexistence of cations and anions, at all pH values below five. The permeability of both anions and cations was maximal at ~pH three, and increased with the addition of chloride ions to the uranyl sulfate solution. The permeability ratio (cation: anion) increased with the increase of the current density and the pH, and was maximal at moderate concentrations of uranyl sulfate. (BBB)

35800 DISSOCIATION ENERGIES OF THE ALKALINE EARTH MONOFLUORIDES. Gary D. Blue, John W. Green, Thomas C. Ehlert, and John L. Margrave (Univ. of Wisconsin, Madison). Nature, 199: 804-5(Aug. 24, 1963).

New results and theoretical calculations are presented that indicate consistently high dissociation energies for all the alkaline earth monofluorides. Experimental results were obtained by utilizing a mass spectrometer to analyze the vapors from a heated Ta Knudsen cell containing an alkaline earth fluoride salt with Al present as a reducing agent. Ionization efficiency curves were obtained and temperature dependence investigations were made to determine the molecular precursor of the ions observed. Values of the equilibrium constants at different temperatures were used together with the free-energy functions to calculate the third law heats of reaction at 298°K. Data are tabulated for the heats of various reactions for Al–MF_2 systems with M = Mg, Ca, Sr, and Ba, and dissociation energies of MF molecules by various methods for Be, Mg, Ca, Sr, and Ba. (C.H.)

35801 THE IGNOBLE GASES: A CHEMICAL SOMERSAULT. Cedric L. Chernick (Argonne National Lab., Ill.). New Scientist, 19: 444-6(Aug. 29, 1963).

Work in preparing compounds of rare gases is discussed. Reactions of xenon with platinum hexafluoride, ruthenium hexafluoride, and fluorine and controlled hydrolysis of XeF_6 to produce XeO_3, $XeOF_4$, and a sodium perxenate are described. Properties of the compounds are listed. Radon and krypton fluorides were also prepared. Possible uses for compounds of the rare gases are discussed. (M.C.G.)

35802 STUDIES ON THE REACTION OF THORIUM WITH GRAPHITE AT HIGH TEMPERATURES. Sakae Takeuchi, Toshio Honma, and Tsuneo Satow (Tohoku Univ., Sendai). Nippon Kinzoku Gakkaishi, 27: 278-83(1963). (In Japanese)

The reaction of thorium metal with graphite was studied in the temperature range of 900 to 1600°C. It was found that the reaction rate was parabolic, and the activation energy for the reaction was 53 kcal/mole below 1200°C. Experiments showed that the growth of carbide film was caused mainly by the migration of carbon. From these results, the rate determining process of the reaction seems to be the diffusion of carbon in the carbide film formed on the metal surface. Hydrocarbons, yielded by hydrolysis of the carbide film, were analyzed by gas chromatographic method, from which the ratio of ThC/ThC_2 in the carbide film was determined. The film formed below 1200°C was composed of ThC only. However, in the film formed above 1300°C the ratio of ThC/ThC_2 decreased with increasing temperature. The activation energy for ThC_2 formation was 140 kcal/mole. The diffusion coefficient of carbon in ThC was calculated from the parabolic rate constants. The amount of thorium carbide, which would form in a thorium blanket of graphite matrix fuel reactor, was estimated. (auth)

35803 ANHYDROUS URANYL NITRATE. B. Jezowska-Trzebiatowska and B. Kedzia. Nukleonika, 8: 101-15(1963). (In Russian)

Anhydrous uranyl nitrate obtained by G. Gibson's and J. J. Katz's modificated method was prepared, using anhydrous UO_3 and N_2O_4. Apparatus for the preparation is proposed. The absorption spectra of anhydrous uranyl nitrate in several organic solvents were obtained. The occurrence of the electronic-vibrational structure in these spectra was confirmed. Similarly as in the spectra of uranyl nitrate hydrates, the ten absorption bands in range 360 to 500 mμ, were identified. Force constants (k_{U-O} = (4.144 + 4.591) × 10^{-5} dyne/cm), interatomic distances (r_{U-O} = 1.81 + 1.84 Å), and dissociation energy (D = 3.47 ev) of uranyl entity in the excited state were calculated. Oscillator strengths were given. Electronic transitions in absorption spectra of uranyl nitrate were identified; in the visible range (about 22000, 24000, and 27000 cm^{-1}) as electronic transitions inside the molecular orbitals of uranyl entity, and in the ultraviolet range as a transition from ligands to uranyl. It was hypothetically assumed, that solubility of uranyl salts in mainly limited by dipole-dipole interaction and covalency of binding in uranyl salts. (auth)

35804 POWDER NEUTRON DIFFRACTION STUDY OF $LiNbO_3$. Yoichi Shiozaki and Toshio Mitsui (Hokkaido Univ., Sapporo). Phys. Chem. Solids, 24: 1057-61(Aug. 1963). (In English)

Crystal structure of $LiNbO_3$ was determined using powder neutron diffraction data. Refinements of the two structure models proposed by Bailey resulted in a unique model, which suggests a disordered distribution of lithium ions in the crystal. A discussion is given of the ferroelectric effect in $LiNbO_3$. (auth)

35805 NEUTRON DIFFRACTION BY Li_2MgPb. William J. Ramsey, Donald E. Sands, and S. Warren Mead (Univ. of California, Livermore). Phys. Chem. Solids, 24: 1066(Aug. 1963). (UCRL-7319-T). (In English)

In order to determine which of the three possible atomic arrangements for face-centered cubic Li_2MgPb is most probable, neutron diffraction studies were conducted on powdered samples of Li_2MgPb. The observed intensities were in agreement with these calculated for Type 2: Pb at (0,0,0), Li at $(\frac{1}{2},\frac{1}{2},\frac{1}{2})$, and Li and Mg at $(\frac{1}{4},\frac{1}{4},\frac{1}{4})(\frac{3}{4},\frac{3}{4},\frac{3}{4})$. (D.L.C.)

35806 VIBRONICS IN GADOLINIUM COMPOUNDS. S. Yatsiv, I. Adato, and A. Goren (Hebrew Univ., Jerusalem). Phys. Rev. Letters, 11: 108-10(Aug. 1, 1963).

The vibroelectronic structure of "internal" electronic transitions in Gd compounds (i.e., transitions corresponding to an internal motion of a molecular group in the compound, in which the Gd ion does not participate) is studied in $GdCl_3 \cdot (6H_2O)$, $GdCl_3 \cdot (6D_2O)$, $Gd_2(SO_4)_3 \cdot (8H_2O)$, $Gd_2(SeO_4)_3 \cdot 8H_2O$, $Gd[(C_2H_5)SO_4]_3 \cdot (9H_2O)$, and $GdPO_4$. All the transitions studied have wavelengths longer than the Gd^{3+} parent-transition wavelength of 3112 to 3120 Å. (T.F.H.)

35807 SUCROSE: PRECISE DETERMINATION OF CRYSTAL AND MOLECULAR STRUCTURE BY NEUTRON DIFFRACTION. George M. Brown and Henri A. Levy (Oak Ridge National Lab., Tenn.). Science, 141: 921-3(Sept. 6, 1963).

The first precise molecular parameters for sucrose are presented. All hydrogen atoms are included. Carbon-carbon distances are 1.51 to 1.53 Å; carbon-oxygen 1.40 to 1.44 Å; carbon-hydrogen 1.08 to 1.11 Å; oxygen-hydrogen 0.94 to 0.99 Å. The furanose ring conformation differs from that in sucrose sodium bromide dihydrate. Hydrogen bonds (two of them intramolecular) utilize every hydroxyl group except one. (auth)

35808 CHLORINE PENTAFLUORIDE. D. F. Smith (Oak Ridge Gaseous Diffusion Plant, Tenn.). Science, 141: 1039-40(Sept. 13, 1963). (TID-19260)

The bonding in the halogen polyfluorides is similar to that in the xenon fluorides. Since XeF_4 exists, the previously unreported ClF_5 should exist. This compound has been prepared by heating ClF_3 in the presence of fluorine at high pressure. Chlorine pentafluoride is a square pyramidal molecule. It has a lower melting point than ClF_3 and a higher vapor pressure. It is also less reactive than ClF_3. (auth)

35809 THERMAL STABILITY OF CERIUM AND NEODYMIUM ACETATES. V. N. Maksimov and K. N. Semenenko. Vestn. Mosk. Univ., Ser. II, Khim., No. 1, 13-17 (Jan.-Feb. 1963). (In Russian)

An analysis was made of thermal stability and crystal structure of prepared compounds of $Ce(CH_3COO)_3 \cdot 1.5H_2O$, $Ce(CH_3COO)_3$, $Nd(CH_3COO)_3 \cdot 4H_2O$, and $Nd(CH_3COO)_3$. (R.V.J.)

35810 SOLUBILITY OF HIGHER TITANIUM, ZIRCONIUM, AND HAFNIUM BROMIDES. S. S. Berdonosov, A. V. Lapitskaya, and L. G. Vlasov. Vestn. Mosk. Univ., Ser. II, Khim., No. 1, 38-9(Jan.-Feb. 1963). (In Russian)

Solubility of $TiBr_4$, $ZrBr_4$, and $HfBr_4$ in 1,2-dichloroethane, chloroform and carbon tetrachloride solutions with variable dielectric constant was investigated. A possibility of complex formation of $TiBr_4$ with CHCl was postulated. (R.V.J.)

35811 INVESTIGATION OF HAFNIUM COMPLEX FORMATION WITH CHLORIDE, NITRATE, AND SULFATE IONS BY THE DISTRIBUTION METHOD. V. M. Peshkova and P'eng Ang. Vestn. Mosk. Univ., Ser. II, Khim., No. 1, 40-2(Jan.-Feb. 1963). (In Russian)

Complex formation of hafnium with chloride, nitrate, and sulfate ions was studied by the distribution method. Stability constants of $HfCl$, $HfSO_4$, and $HfNO_3$ at $\mu = 2.0$, $t = 25 \pm 0.1°$ reduced according to inorganic admixtures: $OH^- > SO_4^{=} > Cl^- > NO_3^-$. The stability constant for Hf with hydroxyl ion was determined previously ($K_1 = 1.32 \times 10^{14}$, $K_2 = 0.58 \times 10^{14}$, $K_3 = 0.39 \times 10^{14}$, and $K_4 = 0.33 \times 10^{14}$. A similar relation was observed with thorium and zirconium complexes. (R.V.J.)

35812 INVESTIGATION OF BERYLLIUM COMPLEX FORMATION BY ION EXCHANGE. I. F. Kolosova and T. A. Belyavskaya. Vestn. Mosk. Univ., Ser. II, Khim., No. 1, 52-7(Jan.-Feb. 1963). (In Russian)

Complex formation of Be in nitric acid solutions was studied by the ion exchange method at $\mu = 0.5[H^+] = 0$, $1[Be^{+2}] = 10^{-6}$, and $t = 18 \pm 0.1°$. Stability constants of $BeNO_3^+$ and $Be(NO_3)_2$ were found to be $\beta_1 = 0.25 \pm 0.5$ and $\beta_2 = 41.6 \pm 2.6$. Beryllium and chloride ions formed three complexes (at $\mu = 0.5$, $[H^+] = 0.1$, and $[Cl^-] = 0.5$ to 0.01) with stability constants $\beta_1 = 12.9 \pm 0.2$, $\beta_2 = 2.0 \pm 0.5$. $\beta_3 = 25.0 \pm 0.5$. Sorption of the first complex $BeCl^+$ by KU-2 cation was $1 = 5.3 \pm 0.2$. (R.V.J.)

35813 INVESTIGATION OF COMPLEX FORMATION OF BENZOYL ACETONE-GADOLINIUM-CHLOROFORM-WATER SYSTEM BY DISTRIBUTION METHOD. M. I. Gromova and G. N. Perelyaeva. Vestn. Mosk. Univ., Ser. II, Khim., No. 1, 58-60(Jan.-Feb. 1963). (In Russian)

Characteristics of complex formation and stability constants of benzoyl acetone-gadolinium-chloroform-water system (Ga content 2×10^{-5}, 8×10^{-5}, and 1×10^{-4} g/ion/l) were analyzed using Rydberg, Bjerrum and Dyrssen-Sillen distribution methods. The tabulated data are in good agreement. (R.V.J.)

35814 INFRARED SPECTRA OF DIBORON TETRAHYDROXIDE B_2OH AND BORON MONOXIDE $(BO)_x$. V. S. Nikitin, A. A. Mal'tsev, M. A. Pchelkina, and Z. F. Vinogradova. Vestn. Mosk. Univ., Ser. II, Khim., No. 3, 14-17 (May-June 1963). (In Russian)

Infrared spectra for $B_2(OH)_4(OD)_4$ and $(BO)_x$ were developed in order to determine the frequency and character of the B-B bond. Wide absorption bands of a white and brown modification of $(BO)_x$ are assumed to be polymer modifications of boron monoxide. Similarity of the brown boron monoxide spectrum with boron anhydride spectrum suggests that the brown modification is the mixture of boron anhydride and boron. Comparison of absorption spectra for diboron tetrahydroxide dehydrated in a vacuum at 600 to 650° and of boron anhydride mixture heated at the same temperature showed that both spectra are identical and confirm the postulation that the brown modification represents a mixture of boron anhydride and boron. (R.V.J.)

35815 X-RAY ANALYSIS OF THORIUM MOLYBDATES AND TUNGSTATES. V. K. Trunov and L. M. Kovba. Vestn. Mosk. Univ., Ser. II, Khim., No. 3, 60-3(May-June 1963). (In Russian)

X-ray phase analysis of stoichiometric mixtures of thorium tungstate and molybdates sintered at 750 to 1000°C showed the presence of $Th(MoO_4)_2$ and $Th(WO_4)_2$ compounds. Thorium molybdate had two modifications with irreversible transformation of $\beta Th(MoO_4)_2 \xrightarrow{\sim 900°} \alpha$-$Th(MoO_4)_2$. The x-ray picture of $Th_{1/4}WO_3$, $Th_{1/3}WO_3$, and $Th_{1/2}WO_3$ specimens exhibited lines of perovskite phase; the specimen of $Th_{1/4}WO_3$ composition had three phases: $Th(WO_4)$, $Th_{1/4}WO_3$, and WO_2. (R.V.J.)

35816 SATURATED VAPOR PRESSURE OF RUTHENIUM TETRAOXIDE. A. B. Nikol'skii (Leningrad State Univ.). Zh. Neorgan. Khim., 8: 1045-8(May 1963). (In Russian)

Pressure of saturated ruthenium tetraoxide at 0.4 to 90.8°C was measured by a statistical method. The heat sublimation, evaporation, melting, and free energy of solid and liquid RuO_4 were estimated at 25°C. (R.V.J.)

35817 ON THE FORM OF ACIDIC SM_2O_3. V. S. Kutsev, E. I. Smagina, and R. N. Morzheedova (State Research Inst. of Rare Earth Industry, "The Giredmet," USSR). Zh. Neorgan. Khim., 8: 1049-52(May 1963). (In Russian)

Reduction of A-form Sm_2O_3 by carbon and metallic zirconium and dissociation in a vacuum were investigated. Non-stoichiometric acidified samarium was produced by heating Sm_2O_3 at 1260 to 2100°. It is shown that B-form of monocline syngony is not a crystalline modification of Sm_2O_3 but a variable composition of acidified samarium. (R.V.J.)

35818 INVESTIGATIONS OF $NdCl_3$–Nd AND $PrCl_3$–Pr SYSTEMS. G. I. Novikov and O. G. Polyachenok (Leningrad State Univ.). Zh. Neorgan. Khim., 8: 1053-9 (May 1963). (In Russian)

Melt diagrams and vapor pressure isotherms at 1800°C were constructed for $NdCl_3$–Nd and $PrCl_3$–Pr systems. The enthalphy (ΔH^0_{298}) and free energy (ΔF^0_{298}) for production of solid $NdCl_2$ and $PrCl_2$ were calculated on the basis of thermographic and tensiometric data ($\Delta H^0_{298} = -169 \pm 3$ kcal/mole and -167 ± 3 kcal/mole and $\Delta F^0_{298} = -158 \pm 4$ kcal/mole and -156 ± 4 kcal/mole). The results are in agreement with published data. (R.V.J.)

35819 THE GADOLINIUM PHOSPHATES. S. M. Petushkov and I. V. Tananaev. Zh. Neorgan. Khim., 8: 1064-9(May 1963). (In Russian)

Solubility, electric conductivity, pH and solid phase analysis of gadolinium phosphates were studied in order to determine the effect of hydrogen ions on $CdCl_3$ reaction with H_3PO_3 and Na_3PO_4. A low-solubility salt $GdPO_4 \cdot H_2O$ is formed by $GdCl_3$ reaction with H_3PO_4. Reactions of $GdCl_3$ with Na_3PO_4 form $9GdPO_4 \cdot Gd(OH)_3 \cdot 27\ H_2O$, $GdPO_4 \cdot H_2O$, and $4GdPO_4 \cdot NaPO_4 \cdot 12H_2O$ depending on the amount of Na_3PO_4. Thermal and x-ray diffraction properties of prepared compounds were also investigated. (R.V.J.)

35820 LANTHANUM PHOSPHATES. I. V. Tananaev and V. P. Vasil'eva (Kurnakov Inst. of General and Inorganic Chemistry, Academy of Sciences, USSR). Zh. Neorgan. Khim., 8: 1070-5(May 1963). (In Russian)

Chemical, thermographic and x ray analyses were made of the $La(NO_3)_3$–H_3PO_4 (NaH_2PO_4, Na_2HPO_4, Na_3PO_4)–H_2O system, and the solubility, specific electric conductivity and pH of the system were determined. It was found that $LaPO_4 \cdot 3H_2O$ precipitate is liberated in all systems, and the system with Na_3PO_4 precipitates also $9LaPO_4 \cdot La(OH)_3 \cdot 28H_2O$ as an analog of hydroxyapatite. The approximate magnitude of $LaPO_4$ solubility product is 3.75×10^{-23}. (R.V.J.)

35821 REDUCTION OF BERYLLIUM OXIDE BY COAL IN PRESENCE OF NICKEL. F. Sh. Muratov and A. V. Novoselova (Moscow State Univ.). Zh. Neorgan. Khim., 8: 1084-7(May 1963). (In Russian)

Reduction of BeO by coal in the presence of Ni was carried out at 1800 to 2050°C. The products obtained contained up to 10 to 15% C. Further refining caused a loss of fine particles in the alloy. A maximum yield of Be in Be–Ni alloy was found at 1900°C (5.0 wt % Be) with considerable graphite inclusions. (R.V.J.)

35822 COMPLEX FORMATION IN ZIRCONIUM–DIANTIPYRYLMETHANE SYSTEM. A. K. Babko and M. I. Shtokalo. Zh. Neorgan. Khim., 8: 1088-92(May 1963). (In Russian)

Production of Zr $(Diant)_2^{4+}$ and Zr $(Diant)_3^{4+}$ in zirconium–diantipyrylmethane systems in 1 N HCl and 0.1 N HCl was studied by a metal-indicator method. For the first complex the stability constant was $K_{Zr(Diant)_2^{4+}} = \{(Zr^{4+})(Diant)^2/[Zr(Diant)_2^{4+}]\} = 3.1 \times 10^{-12}$. (R.V.J.)

35823 INFRARED ABSORPTION SPECTRA OF SCANDIUM CHLORIDE AND BROMIDE COMPOUNDS WITH AMMONIA. Yu. Ya. Kharitonov, V. P. Orlovskii, and I. V. Tananaev (Kurnakov Inst. of General and Inorganic Chemistry, Academy of Sciences, USSR). Zh. Neorgan. Khim., 8: 1093-1103(May 1963). (In Russian)

Infrared absorption spectra (400 to 2000 cm^{-1}) of $ScX_3 \cdot 5NH_3$, $ScX_3 \cdot 4NH_3$, $ScX_3 \cdot 2NH_3$, $ScX_3 \cdot 3NH_3 \cdot 4H_2O$, $ScX_3 \cdot 3NH_3 \cdot 2H_2O$ (where X is Cl or Br) and the same products containing deuterated ammonia or heavy water, $ScCl_3 \cdot 3NH_3 \cdot ScCl_3 \cdot 2NH_3 \cdot 2H_2O$, $ScCl_3 \cdot 6H_2O$, $Sc(OH)_3$ were studied as well as the mechanical mixtures $Sc(OH)_3 + 2(NH_4Cl)$, and $Sc(OH)_3 + 3NH_4Cl$. It was shown that $ScX_3\ nNH_3$ compounds contain coordinated ammonia molecules while $ScX_3 \cdot 3NH_3 \cdot m\ H_2O$ (m = 2.4), $ScCl_3 \cdot 3NH_3 \cdot 3H_2O$, and $ScCl_3 \cdot 2NH_3 \cdot 2H_2O$ do not contain ammonia, and are products of hydrolysis and contain NH_4^+. Moist SC(III) compounds are not capable of containing coordinated ammonia. (R.V.J.)

35824 THERMAL STABILITY OF SCANDIUM HALIDE AMMINES. I. V. Tananaev and V. P. Orlovskii. Zh. Neorgan. Khim., 8: 1104-6(May 1963). (In Russian)

Thermal reactions of gaseous ammonia with anhydrous scandium bromides, chlorides and iodides containing more than 7 ammonia molecules per one of scandium halides were studied in inert gas atmosphere. Thermograms constructed for scandium chloride and bromide ammines showed six endothermal effects and for scandium iodide ammines five effects. The initial three effects in scandium chloride and bromide thermogram are caused by splitting ammonia molecules forming penta-, tetra-, and diammines. In $ScI_3 \cdot 8NH_3$ the first effect forms $ScI_3 \cdot 4NH_3$ and the second $ScI_3 \cdot 2NH_3$. The thermal stability of tetraammines increases with Cl, Br, and I that is characteristic to the first, second, and third ammine groups on the periodical table. Scandium chloride ammines liberate NH_3 and HCl, at 330 to 350°. Scandium bromide and iodide ammines liberate bromine and HI at elevated temperatures. Pure anhydrous scandium chloride was separated at 800 to 900°C. It was also found that thermal treatments of scandium halide do not produce scandium nitrides. (R.V.J.)

35825 COMPLEXING OF ZIRCONIUM WITH INORGANIC ACID ANIONS. K. B. Yatsimirskii and L. P. Raizman (Ivonov Inst. of Chemistry and Tech., USSR). Zh. Neorgan. Khim., 8: 1107-11(May 1963). (In Russian)

Zr forms sulfuric, molybdic, and tungstic acids in dilute solutions form with 1 : 1 metal-admixture ratio. Equilibrium constants for $ZrOSO_4$ and $[ZrMoO_4]^{2+}$ complexes were found, and approximate equilibrium constants were determined for reactions of zirconium oxychloride and sodium tungstate. (R.V.J.)

35826 ON THE COMPLEXITY OF URANYL ACETATE. V. A. Golovnya and L. K. Shubochkin (Kurnakov Inst. of General and Inorganic Chemistry, Academy of Sciences, USSR). Zh. Neorgan. Khim., 8: 1116-21(May 1963). (In Russian)

Studies of molar conductivity in water and methanol solutions of $UO_2 \cdot (CH_3COO)_2 \cdot 2H_2O$ showed that in methanol the compound does not dissociate and behaves as a nonelectrolyte. The same was observed in aqueous solutions indicating that "simple" uranyl acetate is a complex compound with a coordinated formula: $[UO_2(CH_3COO)_2(H_2O)]$ and a type of bond where uranyl has a coordination number of six and the acetate group is bidentate. (R.V.J.)

35827 SOLUBILITY OF $Th(C_2O_4) \cdot 6H_2O$ IN HNO_3 AND $H_2C_2O_4$ AQUEOUS SOLUTIONS AT 25°. A. G. Kurnakova and L. K. Shubochkin. Zh. Neorgan. Khim., 8: 1249-54 (May 1963). (In Russian)

Solubility isotherms at 25° were studied with $Th(C_2O_4)_2-H_2C_2O_4-H_2O$, $Th(C_2O_4)_2-HNO_3-H_2O$ (mutual), $H_2C_2O_4-HNO_3-H_2O$, and $Th(C_2O_4)_2-HNO_3-H_2C_2O_4$ (satur)$-H_2O$. Solubility of thorium oxalate hexahydrates in oxalic acid is very low and does not vary with higher content of $H_2C_2O_4$ (0.0012 to 0.0018% Th). Solubility of $Th(C_2O_4)_2 \cdot 6H_2O$ in 15% nitric acid is higher than in water, however, at higher concentrations and, especially, in HNO_3 solutions it becomes quite high (up to 1% Th). (R.V.J.)

35828 YTTRIUM CHROMATES IN $Y(NO_3)_3-K_2CrO_4-H_2O$ SYSTEM. F. M. Perel'man and E. I. Fedoseeva (Kurnakov Inst. of General and Inorganic Chemistry, Academy of Sciences, USSR). Zh. Neorgan. Khim., 8: 1255-8(May 1963). (In Russian)

Solubility and composition of yttrium chromates formed in the $Y(NO_3)_3-K_2CrO_4-H_2O$ crystal system at 25° were studied. The crystals were of two types: an orange salt $Y_2(CrO_4)_3 \cdot K_2CrO_4 \cdot n\ H_2O$ (where n is almost 6) and a yellow salt of variable composition from $Y_2(CrO_4)_3 \cdot 3K_2CrO_4 \cdot n\ H_2O$. A normal yttrium chromate was synthesized directly from freshly precipitated yttrium hydroxide by reaction with chromium anhydride in aqueous solution followed by water evaporation at room temperature. (R.V.J.)

35829 SOLUBILITY OF CERIUM CARBONATES AND SULFATES IN WATER AT 25°C. A. A. Trofimovich and G. S. Sedel'nikov. Zh. Neorgan. Khim., 8: 1257-64(May 1963). (In Russian)

An analysis of $Ce_2(CO_3)_3-Ce_2(SO_4)_3-H_2O$ system solubility at 25°C indicated that cerium carbonate concentration (0.00016 to 0.00024%) in liquid state varies only slightly while cerium sulfate varies from 0 to 7.64%. A double salt $Ce_2(CO_3)_3 \cdot 2Ce_2(SO_4)_3 \cdot 24H_2O$ forms with cerium sulfate concentration from 1.14 to 7.78% in equilibrium with liquid phase. Concentrations of cerium sulfate solutions with less than 1% with cerium carbonate form mixed crystals, in some cases forming octahydrates of cerium sulfate and carbonate. Reactions of carbon dioxide with cerium carbonate in the $Ce_2(CO_3)_3-CO_2-H_2O$ were also studied at 25°C. (R.V.J.)

35830 STUDIES OF ZIRCONIUM COMPLEX FORMATION WITH SELENOYLTRIFLUOROACETONE BY MEANS OF DISTRIBUTION METHOD. N. V. Mel'chakova and V. M. Peshkova. Zh. Neorgan. Khim., 8: 1280-1(May 1963). (In Russian)

Characteristics of complexing and stability of selenoyltrifluoroacetone with $Zr-C_6H_6-H_2O$ were analyzed. It was found that introduction of β-diketone of CF_3 group improves the reagents and that distribution coefficient for selenoyltrifluoroacetone at smaller reagent concentrations is identical to selenoylacetone. (R.V.J.)

35831 REACTIONS OF NaF WITH HfF_4 IN AQUEOUS SOLUTIONS. B. V. Shchepochkin and N. P. Sazhin. Zh. Neorgan. Khim., 8: 1281-4(May 1963). (In Russian)

Potentiometric and conductometric titration studies and microscopic analysis of reactions of NaF with HfF in aqueous solutions revealed stoichiometric compounds with NaF ratio to HfF equal to 1.5 : 1, 2 : 1, 3 : 1, and 3.75 to 1. A chemical analysis confirmed the synthesis of the following compounds: $Na_3Hf_3F_{11} \cdot H_2O$, Na_2HfF_3, $Na_3HfF_7 \cdot 0.5\ H_2O$, and $Na_{15}Hf_4F_{31} \cdot H_2O$. Microphotographs of crystals of prepared compounds are included. (R.V.J.)

35832 RARE EARTH NICOTINATES. R. A. Chupakhina and V. V. Serebrennikov. Zh. Neorgan. Khim., 8: 1284-6 (May 1963). (In Russian)

Preparation and crystallography of rare earth complexes with nicotinic acid $LnNicot_3$ (where Ln is La, Ce, Pr, Nd, Sm, Eu, Gd, Dy, Ho, Er, Yb, Lu, and Y and nicot is C_5N_4NCOO) are described and water solubility of prepared complexes was determined as 20°C. (R.V.J.)

35833 ON THE EXISTENCE OF TWO MODIFICATIONS OF RuO_4. A. B. Nikol'skii. Zh. Neorgan. Khim., 8: 1289 (May 1963). (In Russian)

Experimental data on RuO_4 solubility in water, saturated vapor pressure, and melting point do not confirm the existence of two (yellow and brown) RuO_4 modifications. (R.V.J.)

35834 ON THE STABILITY OF LOWER VALENCE RARE EARTH CHLORIDES. O. G. Polyachenok and G. I. Novikov (Leningrad State Univ.). Zh. Neorgan. Khim., 8: 1567-73(July 1963). (In Russian)

Colorimetric determination of $NdCl_3$ and $NdCl_2$ heat of formation at −246.5 and −163.2 kcal/mole is in good agreement with the data obtained by thermographic and tensimetric analysis of $NdCl_3-Nd$. The heat of formation for all rare earth dichlorides was calculated using the Born–Gaber cycle of approximations. The possibility of preparing La–Ln dichlorides and their stability are also analyzed. The instability of rare earth monochlorides in solid and liquid phases was confirmed. (R.V.J.)

35835 URANYL SULFATE–FLUORIDE COMPLEXES. I. I. Chernyaev, G. V. Ellert, L. K. Shubochkin, and R. N. Shchelokov (Kurnakov Inst. of General and Inorganic Chemistry, Academy of Sciences, USSR). Zh. Neorgan. Khim., 8: 1584-93(July 1963). (In Russian)

Preparation of fourteen new sulfate-fluoride uranyl compounds $K(UO_2FSO_4)$, $NH_4(UO_2FSO_4)$, $Na[UO_2FSO_4(H_2O)_2]$, $K_2[UO_2F_2(SO_4)H_2O]$, $Na[UO_2F_2(SO_4)(H_2O)_2]$, $K_3[UO_2F_2(SO_4)(H_2O)]$, $Na_3[UO_2F_3(SO_4)H_2O]$, $Na_3[UO_2F(SO_4)_2H_2O]\ 4H_2O$, $K_3[UO_2F(SO_4)_2]$, $K_4[UO_2F_2(SO_4)_2]H_2O$, $(NH_4)_7[(UO_2)_2F_9SO_4]$, $(NH_4)_2[(UO_2)_2F_4(SO_4)(H_2O)_2]$, $(NH_4)_3[(UO_2)_2F_3(SO_4)_2H_2O]$, $Na_5[UO_2F_3(SO_4)H_2O]H_2O$ was described and their properties were analyzed. Potentiometric titration was carried out with aqueous uranyl sulfates by potassium fluoride and aqueous solutions of potassium by uranyl fluorides. (R.V.J.)

35836 HYDROLYSIS AND FORMATION OF URANYL COMPLEXES IN MINERAL ACID SOLUTIONS. B. G. Pozharskii, T. N. Sterlingova, and A. E. Petrova. Zh. Neorgan. Khim., 8: 1594-1611(July 1963). (In Russian)

Uranyl hydrolysis in aqueous solutions of uranyl nitrates at pH < 3.4 follows only the first step reaction: $UO_2^{2+} + H_2O \rightleftharpoons UO_2OH^+ + H^+$. Experiments indicated that the hydrolysis constant is a function of the solution temperature: at 27° the $K_h = (2.55 \pm 0.15) \cdot 10^{-5}$, at 16° the $K_h = 0.9 \times 10^{-5}$. The second step of hydrolysis starts with pH > 3.4 $UO_2OH + H_2O \rightleftharpoons UO_2(OH)_2$. Polymer products of uranyl hydroxide reaction in aqueous solution were analyzed. It is shown that the absence of additional ions in the second step of the reaction is due to the reaction series: $2UO_2^{2+} + 2H_2O \rightleftharpoons 2UO_2OH^+ + 2H^+$, $UO_2OH^+ + H_2O \rightleftharpoons UO_2(OH)_2 + H^+$, $UO_2OH^+ + UO_2(OH)_2 \rightleftharpoons (UO_2)_2(OH)_3^+$, $(UO_2)_2(OH)_3^+ \rightleftharpoons [(UO_2)_2(OH)]^{3+} + 2OH^- + 2H^+ + 2H_2O$, resulting in a formula $2UO_2^{2+} + H_2O \rightleftharpoons [(UO_2)_2(OH)]^{3+} + H^+$. Equilibrium constants were estimated by the pH method for aqueous uranyl sulfate solutions: $UO_2^{2+} + SO_4^{2-} \rightleftharpoons UO_2SO_4$, $UO_2OH^+ + SO_4^{2-} \rightleftharpoons UO_2OHSO_4^-$ where $K_1 = 7 \times 10^3$ and $K_2 = (2.1 \pm 0.5) \times 10^3$. Variations of pH in uranyl nitrate and uranyl chloride solutions indicate that with uranyl nitrate concentration over 0.5 mole/l $UO_2NO_3^+$ and UO_2OHNO_3 ions and possibly $UO_2(NO_3)_2$ are formed in addition to the UO_2^{2+} and UO_2OH^+ ions. Formation of initial complexes UO_2Cl^+ and UO_2OHCl was uncovered with chloride concentration of 0.01 mole. (R.V.J.)

35837 DETERMINATION OF THE COMPOSITION OF U(IV) AND U(VI) COMPLEXES IN AQUEOUS SOLUTIONS. A. L. Gol'dinov and A. I. Stabrovskii. Zh. Neorgan. Khim., 8: 1612-16(July 1963). (In Russian)

An analysis was made of aqueous solutions of U(IV) and U(VI) complexes. Electric conductivity was measured in the following systems: $UO_2SO_4 - Na_2SO_4 - H_2O$, $U(SO_4)_2 - NaSO_4 - H_2O$, $UO_2F_2 - NaF - H_2O$, $UO_2(CH_3COO)_2 - CH_3COONa - H_2O$; $UO_2F_2 - HF - H_2O$, $UO_2(CH_3COO)_2 - Zn(CH_3COO)_2 - H_2O$. The above systems form complex ions $[UO_2(SO_4)_2]^{2-}$, $[U(SO_4)_3]^{2-}$, $[UO_2F_3]^-$, and $[UO_2(CH_3COO)_3]^-$. U(VI) ions are not produced in the $UO_2(CH_3COO)_2 - Zn(CH_3COO)_2 - H_2O$ system. (R.V.J.)

35838 URANIUM(IV) PETAFLUORIDE COMPLEXES. Yu. A. Luk'yanychev, N. S. Nikolaev, and Yu. N. Mikhailov (Kurnakov Inst. of General and Inorganic Chemistry, Academy of Sciences, USSR). Zh. Neorgan. Khim., 8: 1617-22 (July 1963). (In Russian)

Synthesis and chemical properties of uranium pentafluoride complexes with hydroxylamine, hydrazine, and aniline were studied. All prepared salts were thermally unstable. (R.V.J.)

35839 PROPERTIES OF ZIRCONIUM OXYCHLORIDE AQUEOUS SOLUTIONS. A. N. Ermakov, N. N. Marov, and V. K. Belyaeva (Vernadskii Inst. of Geochemistry and Analytical Chemistry, Academy of Sciences, USSR). Zh. Neorgan. Khim., 8: 1623-33(July 1963). (In Russian)

Activity of hydrochloric acid in zirconium oxychloride solutions was determined at 0.2, 10, and 25° and 0.006 to 0.38 mole/kg concentrations. Depression of the freezing point for zirconium oxychlorides was measured as a function of salt concentration or aging of the solution. Diffusion coefficients were found for $ZrOCl_2 \cdot 8H_2O$, $HfOCl_2 \cdot 8H_2O$, and $ThCl_4$ salts. Electric conductivity of zirconium oxychloride was measured at 0.2, 10, 25° and 0.0617 to 0.3868 mole/kg. (R.V.J.)

35840 MELTING POINT OF LITHIUM, POTASSIUM AND LEAD CHLORIDE SYSTEMS. A. G. Bergman, Yu. I. Andryushchenko, and R. K. Bineeva (Rostov-on-Don Research Inst. in Engineering Tech., USSR). Zh. Neorgan. Khim., 8: 1693-7(July 1963). (In Russian)

Liquidus diagram for Li, K, Pb/Cl surface indicated incongruently melting compounds and confirmed the existence of the compounds $2KCl \cdot PbCl$ and $KCl \cdot 2PbCl_2$. It also indicated homeomorphous transformation of LiCl at 563° and PbCl at 425°C. (R.V.J.)

35841 SOLUBILITY IN $SmCl_3 - KCl - H_2O$ AND $YCl_3 - KCl - H_2O$ AT 25 AND 50°C. Z. N. Shevtsova and Wei-Tsuan Ying. Zh. Neorgan. Khim., 8: 1749-52(July 1963). (In Russian)

Solubility isotherms of $SmCl_3 - KCl - H_2O$ and $YCl_3 - KCl - H_2O$ were studied at 25 and 50°C. It was found that the examined system can be described as an uncomplicated single-eutectoid diagram. (R.V.J.)

35842 THE SOLUBILITY ISOTHERM (25°) FOR $Nd(NO_3)_3 - RbNO_3 - HNO_3 - H_2O$. F. M. Perel'man, A. Ya. Zvorykin, and G. A. Demina (Kurnakov Inst. of General and Inorganic Chemistry, Academy of Sciences, USSR). Zh. Neorgan. Khim., 8: 1753-5(July 1963). (In Russian)

A solubility isotherm (at 25°C) was constructed for $Nd(NO_3)_3 - RbNO_3 - HNO_3 - H_2O$ with 24 to 35% HNO_3. It was found that the system forms two binary salts: $4Nd(NO_3)_3 \cdot 5RbNO_3$ and $2Nd(NO_3)_3 \cdot 7.5\ RbNO_3$. Properties of neodymium and praseodymium nitrates in nitric acid with rubidium nitrate were correlated. (R.V.J.)

35843 ON THE SATURATED VAPOR PRESSURE IN $LaCl_3 - La$, $PrCl_3 - Pr$, AND $NdCl_3 - Nd$ SYSTEMS. O. G. Polyachenok and G. I. Novikov (Leningrad State Univ.). Zh. Neorgan. Khim., 8: 1785-6(July 1963). (In Russian)

Results of previous studies of melting point and saturated vapor pressure at 1180°C in $PrCl_3 - Pr$, $NdCl_3 - Nd$ (18% Nd), and $LaCl_3 - La$ are analyzed and further studies were made and techniques improved expanding the data of the investigation to 1350°. The saturated vapor pressure-composition curve indicated that an atomic dissolution of metal takes place in La and two-charged ions in Pr and Nd. For $NdCl_2$ the heat of reaction $3NdCl_{liquid} \rightleftharpoons 2NdCl_{3liquid} + Nd_{liquid}$ is 38 ± 10 kcal at 1250°C and for $PrCl_2$ it is 24 ± 10 kcal at 1230°C. (R.V.J.)

35844 SOLUBILITY OF URANIUM TETRAFLUORIDE. Yu. A. Luk'yanychev and N. S. Nikolaev (Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR). Zh. Neorgan. Khim., 8: 1786-8(July 1963). (In Russian)

Solubility of $UF_4 \cdot 2.5\ H_2O$ in aluminum sulfate solution was studied and the solubility of the produced salt was calculated by the Tananaev method. The mean solubility of UF_4 was found to be 5.8×10^{-22} which is in good agreement with the value 5.7×10^{-22} previously determined for UF_4 solubility in perchloric acid. (R.V.J.)

35845 ISOTHERMS OF GASEOUS ADSORPTION ON BAU COAL AT LOW TEMPERATURES AND 10^{-9} TO 10^{-2} mm Hg PRESSURES. I. ISOTHERMS OF DEUTERIUM AND HYDROGEN ADSORPTION. M. F. Fedorova (Inst. of Physics and Tech., Khar'kov). Zh. Tekhn. Fiz., 33: 585-91(May 1963). (In Russian)

Descriptions are given of the installation, method, and results obtained in determining the equilibrium hydrogen–deuterium pressure over BAU coal at 4.2, 20.4, and 80°K at 10^{-9} to 10^{-2} mm Hg pressure. (R.V.J.)

35846 THE THERMOCHEMICAL PROPERTIES OF URANIUM COMPOUNDS. M. H. Rand and O. Kubaschewski. New York, Interscience Publishers, 1963. 96p.

Thermodynamic and chemical properties of uranium,

uranium ions in solution, and uranium compounds and alloys, including halides, oxides, sulfides, carbides, hydrides, compounds with Group V and IV B elements, and Group III and II metals and alloys with Group I metals (U–Au), U–Fe, uranyl compounds, and miscellaneous compounds are given. Practical application of the data is discussed. (Rev. Metal Lit., 20: No. 8, Aug. 1963)

35847 THE PYROLYTIC DECOMPOSITION OF O-, M-, AND P-TERPHENYLS AND OTHER POTENTIAL REACTOR COOLANTS. G. Juppe, H. Hannaert, and F. Biver (Euratom, Ispra, Italy). 30p. (CONF-14-35)

From American Chemical Society 144th National Meeting, Los Angeles, Mar. 1963.

Experiments were made on the pyrolytic decomposition of o-, m-, and p-terphenyls and mixtures of terphenyls with diphenyl. The effects of competing reactions were also studied by initially adding hydrogen, methane, ethane, propane, and benzene. The results indicate that the disappearance of o-, m-, and p-terphenyl seems to follow formally a first order reaction mechanism. The relative stability of the pure individual components increases in the order: o-terphenyl (least stable), p-terphenyl, m-terphenyl (most stable). The activation energy was found to be in the neighborhood of 64 kcal/mole. The activation energy for the diphenyl formation during pyrolysis of an irradiated biphenyl-terphenyl mixture was found to be 47.9 kcal/mole. (P.C.H.)

35848 URANIUM GLASSES. I. GLASS FORMATION AND PROPERTIES IN THE SYSTEM $M_2O-UO_2-B_2O_3$ (M^{+1} = Li^{+1}, Na^{+1}, K^{+1}). J. Ciric and M. Krishna Murthy (Ontario Research Foundation, Toronto). 32p. (CONF-50-17)

From American Ceramic Society 65th Annual Meeting, Pittsburgh, Apr.-May 1963.

Glass-forming regions in the systems $Li_2O-UO_2-B_2O_3$, $Na_2O-UO_2-B_2O_3$, and $K_2O-UO_2-B_2O_3$ were established with a view to providing experimental data on uranium glasses. The reaction between UO_2 and B_2O_3 is very slow and, therefore, it is not possible to prepare glasses in this system. With the addition of alkali, however, glass formation takes place easily. In the system $Li_2O-UO_2-B_2O_3$ the region of glass formation is restricted to compositions containing 20% Li_2O (by weight) and not more than 50–60% UO_2 with the exception of one composition. The extent of glass formation in the system $Na_2O-UO_2-B_2O_3$ is approximately the same as in the lithium system; but, in the potassium system the area of glass formation is very small. In mixed-alkali glasses, the area of glass formation is similar to those in lithium and sodium systems. (auth)

35849 INITIAL RECOMBINATION OF IONS IN GASES (AIR). J. Booz and H. G. Ebert (Institut für Medizinische Physik, Göttingen, Ger.). 13p. (CONF-19-1). (In German)

From International Congress of Radiation Research, Harrogate, Eng., Aug. 1962.

The dependence of the initial recombination coefficients on the ion density, the ionization length, and the recombination time was theoretically and experimentally investigated for the case of ionization of air with x rays. The experiments were carried out at initial ion densities between 5×10^4 and 2×10^6 ion pairs/cm^3 and at ionization lengths between 100 μsec and 3 msec. There was satisfactory agreement with the theoretically derived formula. (tr-auth)

35850 PREPARATION OF REFRACTORY OXIDE MICROSPHERE. C. C. Haws, Jr. (to U. S. Atomic Energy Commission). U. S. Patent 3,105,052. Sept. 24, 1963.

A method is described of preparing thorium oxide in the form of fused spherical particles about 1 to 2 microns in diameter. A combustible organic solution of thorium nitrate containing additive metal values is dispersed into a reflected, oxygen-fed flame at a temperature above the melting point of the resulting oxide. The metal additive is aluminum at a proportion such as to provide 1 to 10 weight per cent aluminum oxide in the product, silicon at the same proportion, or beryllium at a proportion of 12 to 25 weight per cent beryllium oxide in the product. A minor proportion of uranium values may also be provided in the solution. The metal additive lowers the oxide melting point and allows fusion and sphere formation in conventional equipment. The product particles are suitable for use in thorium oxide slurries for nuclear reactors. (AEC)

Organic Chemistry

35851 (CONF-14-19) PROTON MAGNETIC RESONANCE STUDIES OF HYDROGEN BONDING OF BENZENETHIOL WITH SEVERAL HYDROGEN ACCEPTORS. Raj Mathur, Edwin D. Becker, Robert B. Bradley, and Norman C. Li (National Inst. of Arthritis and Metabolic Diseases, Bethesda, Md.). [1962]. Contract [AT(30-1)-1922]. 24p.

From American Chemical Society Meeting, Los Angeles, March–April 1963.

Proton magnetic resonance studies of hydrogen bonding between the S–H proton of benzenethiol and the hydrogen acceptors dimethylformamide, pyridine, N-methylpyrazole, tributyl phosphate, and benzene, all in CCl_4 solution, are reported. Data on the variation of the chemical shift of the S–H proton as a function of the concentration of hydrogen acceptor are treated graphically in a manner which permitted the determination of both the hydrogen bond shift, Δ_c, and the equilibrium constant for formation of a 1 : 1 complex, K. The enthalpy change on hydrogen bond formation was determined from the variation of K with temperature. For the benzenethiol-dimethylformamide system, for which the most complete results were obtained, Δ_c appears to be independent of temperature over the range –12 to 68°C. (auth)

35852 (IS-657) SOME OBSERVATIONS ON RARE EARTH SALTS OF TRICARBALLYLIC ACID (PROPANE-1,2,3-TRICARBOXYLIC ACID). HYDRATION AND SOLUBILITY OF THE COMPOUNDS. Asim K. Gupta and Jack E. Powell (Ames Lab., Ames, Iowa). July 1963. Contract W-7405-eng-82. 12p.

Rare earth tricarballylates were prepared by interaction of rare earth chlorides and an equivalent amount of the di- or trisodium salt of tricarballylic acid. Rare earth tricarballylates precipitated immediately in cold. These were found to be very insoluble. Except for the lanthanum species, all the rare earth compounds including yttrium tricarballylate were found to have a hydration number of four. Lanthanum alone was found to form a pentahydrate. A solubility study at two different temperatures (20 and 60°C) and a study of the thermal decomposition of the hydrates by means of a thermogravimetric balance were made which indicated that, though the "as-prepared" rare earth tricarballylate compounds, in general, have the same hydration, they decompose differently. (auth)

35853 SYNTHESIS OF 3,5-DIIODO-L-THYRONINE LABELED WITH TRITIUM IN THE 2′ OR 6′ POSITIONS AND OF ITS HORMONAL DERIVATIVES. Raymond Michel, Roher Truchot, Henri Tron-Loisel, and Bernard Poillot

(Ecole de Medecine et de Pharmacie, Dijon, France). Bull. Soc; Chim. Biol., 42: 1207-11(1960). (In French)

3,5,3′-Triiodo-L-thyronine and L-thyroxine labeled with H^3 in 2′ or 6′ positions were prepared by iodination of 3,5-diiodo-L-thyronine tritiated at 2′ or 6′. The synthesis of the latter compound was accomplished in four steps. 3-iodoanisol is reduced catalytically by H_2^3 to meta-labeled anisol. This product is converted to p,p′-dianisyliodonium bromide which is condensed with N-acetyl-3,5-diiodo-L-tyrosine ethyl ester to yield radioactive O-methyl-N-acetyl-3,5-diiodo-L-thyronine ethyl ester. By hydrolysis with HI, this substance is transformed into 3,5-diiodo-L-thyronine labeled at 2′ or 6′. Its max specific molar activity may reach 1 g-atom H^3. A microhydrogenation apparatus is described and illustrated. By use in this apparatus of H_2^3 diluted with H_2, and containing 57 mC/ml gas at atm pressure, the 3,5-diiodo-L-thyronine obtained had a specific activity of 1.2 $\mu C/\mu g$, which was $1/_{50}$ of that obtained with H_2^3 of 97% purity. (BBB)

35854 SYNTHESIS OF DEUTERIATED METHYL BENZOATES AND DIMETHYL PHTHALATES. R. Phillips and L. C. Leitch (National Research Council, Ottawa). Can. J. Chem., 41: 2389-90(Sept. 1963). (NRC-7471)

As part of an investigation of the infrared spectra of carbonyl compounds, the following deuterated methyl benzoates and dimethyl phthalates were synthesized: $C_6H_5CO_2CD_3$, $C_6D_5CO_2CH_3$, $C_6D_5CO_2CD_3$, $C_6H_4(CO_2CD_3)_2$, $C_6D_4(CO_2CH_3)_2$, and $C_6D_4(CO_2CD_3)_2$. The deuterium contents of the compounds were determined by the method of Jones and MacKenzie. (M.C.G.)

35855 SYNTHESIS OF TRITIUM-LABELED AMINO ACIDS WITH INCREASED SPECIFIC ACTIVITY. Leonard Birkofer and Klaus Hempel (Universität, Cologne). Chem. Ber., 96: 1373-81(1963). (In German)

Methods for amino acid synthesis are described that involve the catalytic reduction of precursor aliphatic acids and aromatic amino acids, and the catalytic dehalogenation with tritium of brominated and iodinated precursors. The following amino acids were synthesized: DL-alanine-$\alpha,\beta T_2$ (from α-acetaminoacrylic acid ethyl ester) with a specific activity of 4500 mc/mmole; DL-glutamic acid-$\beta,\gamma T_2$ (from acetamino-(2-carbethoxyvinyl)malonic acid diethyl ester), 3000; γ-aminobutyric acid-$\alpha,\beta T_2$ (γ-phthalimidocrotonic acid methyl ester), ---; DL-α-aminoadipic acid-4,5T_2 (acetamino-(3-carbethoxy-Δ^1-propenyl)malonic acid diethyl ester), 55000; DL-β-(3,4-dihydroxyphenyl)-alanine-$\alpha,\beta T_2$ (α-acetamino-β-(3,4-diacetoxyphenyl)acrylic acid, 9000; and DL-proline-2T (Δ^1-pyrrolinecarboxylic acid hydrochloride), 1500. Reduction was carried out with a palladium-activated charcoal catalyst for periods of 3 min, 1 hr, 1.05 hr, 1.5 hr, and 2.5 hr for these respective compounds. For the compounds with the lower activities, a mixture of H_2 and T_2 was used. Methods for synthesizing the following are also described: L-tyrosine-3T, L-histidine-2,4T, and D- and L-phenylalanine-2,4T. Paper chromatography showed that the purity of the products, with few exceptions exceeded 98%. (BBB)

35856 A MASS-SPECTROGRAPHIC STUDY OF HYDROCARBONS. METHYL ESTERS AND ACETATES OF THE GLYCOSIDES. N. K. Kochetkov, N. S. Vul'fson, O. S. Chizhov, and B. M. Zolotarev (Inst. for the Chemistry of Natural Compounds, Academy of Sciences, USSR). Dokl. Akad. Nauk SSSR, 151: 336-9(July 11, 1963). (In Russian)

The mass spectra of 2,3,4,6-tetramethyl-α-methyl glucoside, 2,3,4,6-tetramethyl-β-methyl glucoside, 2,3,4,6-tetramethyl-α-methyl galactoside, 2,3,4,6-tetramethyl-β-methyl galactoside, 2,3,4,6-tetramethyl-α-methyl mannoside, and 2,3,4,6-tetramethyl-β-methyl mannoside were determined and the results of the fragmentation of these methylated glycosides were compared with those of methylated monosaccharides with a free glucoside hydroxyl, for the purpose of evaluating the possible use of glycosides for analytical purposes. It was found that the mass spectra allow for clear differentiation between the methyl glycosides and may be used for the determination of the configuration. In order to further the application of these compounds, the volatility of the carbohydrates was increased by acetylation and the mass spectra of compounds such as 2,3,4,6-tetraacetyl-α-methyl galactoside and its corresponding β-compound were determined. The mass spectra of the compounds tested agreed with each other within experimental error (6%) and therefore are not suitable for analytical purposes. (TTT)

35857 ELIMINATION MECHANISMS. POSITION OF PROTON IN E2 TRANSITION STATES. Louis J. Steffa and Edward R. Thornton (Univ. of Pennsylvania, Philadelphia). J. Am. Chem. Soc., 85: 2680-1(Sept. 5, 1963).

It was found that the isotope effects for DO^- in D_2O vs HO^- in H_2O as attacking bases in the E2 elimination reactions of two β-phenylethyl derivatives at 80°C are 1.79 for $C_6H_5CH_2CH_2N^+(CH_3)_3Br^-$ and 1.57 for $C_6H_5CH_2CH_2S^+(CH_3)_2$ Br^- salts. It was concluded that the proton is almost completely transferred to oxygen in the transition state for E2 elimination by HO^- in H_2O on $C_6H_5CH_2CH_2N^+(CH_3)_2$. For the corresponding sulfonium ion, the proton was less completely transferred, and for the bromide, the proton is still less completely transferred. (M.C.G.)

35858 POLYMERIC LIGANDS. IV. POLYVINYL β-KETOESTERS. C. J. Berninger, R. C. Degeiso, L. G. Donaruma, A. G. Scott, and E. A. Tomic (E. I du Pont de Nemours and Co., Wilmington, Del.). J. Appl. Polymer Sci., 7: 1797-1801(Sept. 1963).

Copolymers were prepared by ester interchange of polyvinylalcohol with ethyl acetoacetate, ethyl benzoylacetate, and ethyl 4-nitrobenzoylacetate. Reaction of ethyl 2,4,6-trimethylbenzoylacetate with polyvinylalcohol yielded a homopolymer. The polymers functioned as chelate ion exchangers. Ion exchange capacities were determined for the polymer derived from polyvinylalcohol and ethyl acetoacetate. (auth)

35859 DIRECT DETERMINATION OF EXCITON INTERACTIONS FOR TRIPLET STATES OF ORGANIC CRYSTALS. G. C. Nieman and G. W. Robinson (California Inst. of Tech., Pasadena). J. Chem. Phys., 39: 1298-1307 (Sept. 1, 1963).

A method is described that allows the direct measurement of triplet exciton interactions in organic π-electron crystals. Rapid triplet-triplet annihilation prevents the observation of emission from the triplet state in pure crystals of these molecules. Use of isotopic mixed crystals which retard the annihilation process, combined with what can be called the method of variation of energy denominators, allowed an experimental value of the interaction matrix element to be obtained. Application of these methods to dilute mixed crystals of C_6H_6 in C_6D_6, $C_6H_5D_3$, and $C_6H_4D_2$ gave 12 ± 1 cm^{-1} for the nearest neighbor, "pair" interaction matrix element in crystalline benzene. This value was in good agreement with an earlier lower limit of 8 cm^{-1} obtained from excitation-transfer studies in these crystals. The relationship between the matrix element and the triplet exciton band structure in pure crystalline benzene is discussed, and it is noted that the triplet factor group splitting in crystalline aromatics is

likely of sufficient magnitude to be easily observed in the absorption spectrum of such systems. Application of the methods to the lowest singlet exciton band of crystalline C_6H_6 indicated that the commonly accepted analysis of the factor group splitting is probably incorrect. Barring quenching mechanisms, the relatively large triplet exciton interaction allows roughly 10^{12} nearest-neighbor triplet excitation transfer transitions to occur per triplet-state lifetime in aggregates of these molecules, a fact which should have important bearing on energy transfer in chemical and biological systems. (auth)

35860 SECONDARY HYDROGEN ISOTOPE EFFECTS ON DEOXYMERCURATION. Maurice M. Kreevoy and Bruce M. Eisen (Univ. of Minnesota, Minneapolis). J. Org. Chem., 28: 2104-6(Aug. 1963).

Secondary isotope effects on the rate of acid-induced deoxymercuration of 2-phenyl-2-methoxyethylmercuric iodide were studied. Deuterium substitution at the 2-carbon gives k_H/k_D, 1.12. Deuterium substitution at the 1-carbon gives k_H/k_D, 0.91. The latter is one of a small number of inverse isotope effects that were observed. From these and results previously presented it was concluded that the deoxymercuration transition state has a partial positive charge on the carbon from which oxygen is leaving and also has some olefin-mercuric iodide complex character. (auth)

35861 PROCESS FOR MANUFACTURING GRAFT COPOLYMERS OF POLYOLEFINES AND STYRENE. Lawrence Callaghan, Solomon Harris Pinner, John Frederick Salmon, and Robert Roy Smith (to B. X. Plastics Ltd.). British Patent 935,013. Aug. 21, 1963. Filed May 27, 1959.

A process for the manufacture of a graft copolymer derived from a polyolefin and styrene is patented. A polyolefin film is contacted with styrene in the presence of an aliphatic polyamine, which may be a polyalkylene amine such as tetraethylene pentamine. The contact is made at a temperature that causes the styrene to swell the film without dissolving it. The polyolefin film is pretreated by subjecting it to thermal, ultraviolet, or high-energy radiation to form polymerization-initiating centers. The polyolefin may be polyethylene or polypropylene. The process is carried out in a stainless steel reaction vessel in a N atmosphere. The graft copolymers obtained by the process are especially suitable for conversion into perm-selective membranes. (M.P.G.)

Radiation Chemistry and Radiochemistry

Refer also to abstracts 35775, 35787, 35789, 35790, 35791, 35793, and 35871.

35862 (AERE-R-3086) TRITIUM BREMSSTRAHLUNG AND ITS APPLICATIONS. J. F. Cameron, J. R. Rhodes, and P. F. Berry (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Oct. 1959. Regraded Aug. 1963. 37p.

The construction and properties of 0 to 18-kev electromagnetic radiation sources consisting of tritium adsorbed into a thin layer of Ti or Zr are described. The bremsstrahlung and x radiation emitted are characteristic of the absorbing layer. Uses of these sources in fluorescence analysis and thickness measurement are outlined. (auth)

35863 (AERI-C/R-1) REACTION OF AMINES AND ORGANIC HALOGEN COMPOUNDS UNDER IRRADIATION. You Sun Kim (Atomic Energy Research Inst., Seoul, Korea). Mar. 31, 1963. 11p.

The reactions between organic halides (CCl_4, C_6H_5Cl, C_6H_5Br, C_6H_5I) and amines ($C_6H_5NH_2$, $(C_2H_5)_2NH$, R_3N, $(CH_2)_5NH$, Pyridine) were studied under uv irradiation. The modes of reactions were examined by means of gas chromatography and product-reactant ratio determination. The reaction of CCl_4 with amines gave chloroform and hexachloroethanes, and the reaction of aromatic halides with amines gave biphenyl and benzene. In each series of reactions mainly corresponding amine hydrohalides, but no amination products, were obtained. The reactivity was in order of the basicity of amines and of the reactivity of organic halides, except in the case of cyclic tertiary amine. A comparative reaction of aniline and halogen containing carboxylic acids (CF_3COOH, $ClCH_2COOH$, $CH_3CHCl-COOH$, o-chloro benzoic acid, $C_6H_5-CHCl-CHCl-COOH$) gave mainly aniline hydrohalides forming the coupling products without distinct amination reaction. The same reaction with carboxylic ester of the type of $CF_3COOC_2H_5$, $ClCH_2COOC_2H_5$, and $C_6H_5-CHCl-CHCl-COOC_2H_5$ gave a slight quantity of amide without forming aniline hydrohalides, except the case of ethyl chloroacetate which formed exclusively aniline hydrohalide. Further extension of the reaction of phenyl halides with aniline and substituted aniline ($C_6H_4(NH_2)I$) under x-ray irradiation gave no aniline hydrohalides with deposition of trace quantity of I_2 in the case of iodides series. An after effect reaction indicating aniline damage after irradiation was observed. The results were interpreted as a non-chain photodecomposition process. A competitive proton abstraction via a formation of an intermediate complex was proposed as the reaction path. (auth)

35864 (AERI-C/R-3) PREPARATION OF $Pm^{149,151}$ BY SOLVENT EXTRACTION (BY DISCONTINUOUS COUNTERCURRENT EXTRACTION). C. T. Rhee, S. Y. Lee, and S. H. Kim (Atomic Energy Research Inst., Seoul, Korea). Oct. 1962. 4p.

The quantitative study of mutual separation of lanthanons by nongradient solvent extraction system was undertaken. As an example, the recovery of pure $Pm^{149,151}$ activity from irradiated Nd_2O_3 was chosen. The di-(2-ethylhexyl) phosphoric acid (HDEHP) was chosen as organic solvent since the separation factor of adjacent lanthanons with HDEHP is higher (~2.5) than that with TBP (~1.9). This work can be extended to the preparation of Eu^{155}, Tb^{161}, Tm^{171}, and Lu^{177} from irradiated Sm, Gd, Er, and Yb target in the carrier-free state. (auth)

35865 (BNL-6423) THE RADIOLYSIS OF THE XYLENE ISOMERS AND ETHYLBENZENE. D. Verdin (United Kingdom Atomic Energy Authority. Research Group. Wantage Research Lab., Wantage, Berks, England and Brookhaven National Lab., Upton, N. Y.). [1962]. Contract AT-30-2-GEN-16. 21p.

The G-values for the formation of H_2 and CH_4 in the Co^{60} γ radiolysis of the xylene isomers and ethylbenzene were compared. The presence of iodine does not affect G_{H_2}, but reduces G_{CH_4} to a limiting value. For p-xylene, G_{H_2} and the unscavengeable CH_4 yield are independent of temperature from 20 to 110°C, whereas the total CH_4 yield increases six-fold over this range. The H_2 and CH_4 yields are greatly reduced in the solid state, and in the liquids state benzene shows a protective effect on the yields of both gases. The formation of CH_4 and C_2-hydrocarbons was compared with the C_6- and C_7-products for p-xylene and ethylbenzene, and

isomerization is shown to occur to a negligible extent. The production of high-molecular-weight products was measured for the xylenes, and is independent of dose rate and temperature for liquid p-xylene, but is decreased in the solid state. The results are qualitatively consistent with the reactions of radicals and excited molecules. (auth)

35866 (BNL-6472) ELECTRON SPIN RESONANCE STUDIES OF GAMMA-IRRADIATED FERROCENE. Eiichi Saito (Brookhaven National Lab., Upton, N. Y.). [1962]. Contract [AT(30-2)-Gen-16]. 28p.

The irradiations were carried out on the powder at 77°K and on the single crystals at 193°K. The variation of the splitting factor, g, of the signals observed when the single crystals were orientated at different angles relative to the external magnetic field direction, indicated the existence of three types of resonance peaks. It was possible to correlate these variations with the molecular orientations in the crystal unit cell and with the spatial arrangement of the molecular orbitals. Taking into account the spectral changes observed after thermal annealing of the crystal, the existence of the following free radicals is suggested: 1) a straight molecule-ferricinium ion, 2) a bent molecule-ferricinium ion, and 3) a cyclopentadienyl radical with four protons, the fifth having been transferred to the iron atom. A signal with a cylindrically symmetric g tensor, observed at 77°K, was assigned to another radical but its nature was not fully established. (auth)

35867 (BNL-7135) THE INTERPRETATION OF ANNEALING REACTIONS OF RECOIL ATOMS IN THE SOLID STATE. Garman Harbottle (Brookhaven National Lab., Upton, N. Y.). [1963]. Contract [AT(30-2)-Gen-16]. 27p. (CONF-188-1)

From Proceedings of the 1st Inter-American Conference on Radiochemistry, Montevideo, July 1963.

A review is presented of the field of hot-atom chemistry with emphasis on annealing reactions due to heat, ionizing radiation, or light following neutron irradiation. The problem of finding the mechanism of annealing reactions is considered. Theoretical studies were made to derive isothermal annealing curves from an assumed spectrum of activation energies. The good agreement between theory and experiment indicates that annealing reactions are governed by a broad distribution of many activation energies. (D.L.C.)

35868 (EIR-50) RADIATION INDUCED FORMATION OF LIGHT WATER FROM ION EXCHANGE RESINS IMMERSED IN HEAVY WATER. P. Baertschi and R. Haeberli (Switzerland. Eidgenössisches Institut für Reaktorforschung, Würenlingen). May 1963. 10p.

In an operating heavy water reactor, the ion exchange resins used in the purification system are subjected to long term irradiation. Under these conditions some of the C–H– linkages in the resin structure are destroyed, a process which finally leads to the formation of H_2O and to a corresponding dilution of the D_2O-moderator. This radiation-induced formation of H_2O was measured by γ-irradiation of ion exchange resins immersed in D_2O. From these experiments, the production of H_2O per gram of dry resin e.g. at a dose of 10^8 r was found to be 0.3 g for Duolite A-102D, 0.008 g for Duolite C-20, and 0.03 g for the 1:1 mixed bed. The dilution rate of the D_2O in the DIORIT research reactor due to this effect was calculated to be about 0.003% per year, thus being small compared to the observed overall dilution rate of 0.02% per year. (auth)

35869 (RIA-62-4163) POLYMERIZATION OF ALLYL MONOMERS BY MEANS OF GAMMA RADIATION. W. Dennis McHenry (Rock Island Arsenal Lab., Ill.). Dec. 14, 1962. 22p. (AD-295908)

Polymers of allyl alcohol, allyl acetate, allyl phenyl ether, and allyl isothiocyanate were produced from the monomers by the action of gamma radiation from Co^{60}. Polymerization rates and solubilities of the polymers are given. Molecular weights were determined for polyallyl acetate and polyallylphenyl ether. Infrared spectra for polyallyl alcohol and polyallylphenyl ether are presented. (auth)

35870 (TID-17329) RELATIVE REACTIVITIES OF POSITIONS ON BIPHENYL IN THE GENERATION OF REACTIVE SPECIES BY ELECTRON IRRADIATION AND IN SUBSEQUENT RING SUBSTITUTION. Research Division Report 3294-62R. W. M. Hutchinson, P. S. Hudson, and R. C. Doss (Phillips Petroleum Co. Research Div., Bartlesville, Okla.). [Nov. 9, 1962]. Contract [AT(10-1)-1080]. 16p.

A model is proposed to separate the relative reactivities of the three different positions on biphenyl in the generation of reactive species by ionizing radiation and the relative reactivities of the same positions on biphenyl in its substitution by the reactive species. The method depends on quantitative analysis of the six isomeric quaterphenyl products. Relative yields of these products from irradiation of biphenyl with electrons at 80 and 300°C were obtained and used to check the model. The model fits the experimental data well. Results indicate that the net production of reactive species is not random, that species other than free radicals are formed, and that there is considerable hindrance to ortho-substitution at 300°C. (auth)

35871 (TID-19220) γ-IRRADIATION AND RADICAL INITIATED POLYMERIZATION OF N,N-DIMETHYLETHENESULFONAMIDE. Richard H. Wiley and Peter Jaeger (Louisville, Ky. Univ. Coll. of Arts and Sciences). [1962]. Contract AT(40-1)-229 and 2055. 8p.

The gamma-irradiation induced polymerization of N,N-dimethylethenesulfonamide was studied in the liquid, super-cooled liquid, and solid states from −50 to 42°C. The polymerization is relatively slow (0.8%/hr) at 0.13 Mr/hr and is inhibited in the solid state. The activation energy, −2.4 kcal/mole, indicates an ionic process. The radical-initiated (peroxide, azobisisobutyronitrile, UV) polymerization gives low molecular weight products. The marked decrease in rate for the N,N-dimethyl derivative as compared to that for ethenesulfonamide itself is attributed to an increased irradiation instability associated with N-methyl structures which parallels that for amides and N-methylamides in carbon tetrachloride. (auth)

35872 (UJV-952) LOCALIZATION OF ENERGY IN THE RADIOLYSIS OF SOLUTIONS. PART I. AQUEOUS SOLUTIONS OF NITRATE. J. Bednář (Československá Akademie Věd. Ustav Jaderného Výzkumu, Řež). [1963]. 13p.

In the study of radiolysis of concentrated solutions of sodium nitrate with Co^{60} gamma radiation in the presence of a second solute, also in high concentration, some effects inexplicable by secondary radical mechanism were observed. These effects seemed to give some evidence for non-proportional deposition of absorbed energy. (auth)

35873 ISOTOPE EFFECTS IN X-RAY-IRRADIATED ACIDIFIED H_2O-D_2O SOLUTIONS. Chava Lifshitz (Hebrew Univ., Jerusalem). Can. J. Chem., 41: 2175-86 (Sept. 1963).

H_2O-D_2O mixtures containing 0.1 to 1 N H_2SO_4 were irradiated by 200-kev x rays. The molecular isotope

effect, $\alpha_M = (H/D)_{H_2}/(H/D)_{H_2O}$, was determined from experiments on KBr solutions. The atomic isotope effect, $\alpha_A = (H/D)_H/(H/D)_{H_2O}$, was determined from experiments on ethanol solutions. At 96% D_2O, $\alpha_A = 3.7 \pm 0.5$ and $\alpha_M = 4.0 \pm 0.2$. The isotope effects are discussed in connection with the radiation-chemical reaction $H_3O^+ + eH_2O \rightarrow H + 2H_2O$. The connection between the atomic and molecular hydrogen is discussed. It was concluded that the relation between the observed atomic and molecular isotope effects is not contrary to a hydrogen atom recombination reaction leading to the molecular product. Isotope effects due to the oxidation of Fe^{+2} ions by hydrogen atoms in acid solutions were measured and the mechanism of this reaction is discussed. (auth)

35874 REARRANGEMENT STUDIES WITH C^{14}. XV. ETHYL-2-C^{14} IODIDE FROM THE IRRADIATION OF ETHYL-1-C^{14} IODIDE WITH COBALT-60 GAMMA RAYS. I. S. Bhardwaj and C. C. Lee (Univ. of Saskatchewan, Saskatoon). Can. J. Chem., 41: 2368-71(Sept. 1963).

Irradiation of ethyl-1-C^{14} iodide gave ethyl-2-C^{14} iodide with G_r of 0.27 to 0.28 for samples that were either deaerated or not deaerated. Addition of 1% by weight of iodine before irradiation decreased the extent of rearrangement to nearly zero. The occurrence of 1,2-hydrogen shifts in ethyl radicals outside of the spurs, which may be susceptible to scavenger action, is suggested as a possible path which would lead to the ethyl-2-C^{14} iodide. (auth)

35875 THE OXIDATION OF FERROUS SULPHATE BY Co^{60} γ-RADIATION. E. Onat, R. L. Haines, and I. H. S. Henderson (Defence Research Chemical Labs., Ottawa). Can. J. Chem., 41: 2372-9(Sept. 1963). (DRCL-416)

An investigation of the Co^{60} γ-oxidation of ferrous sulfate in the range 0.015 to 0.15 M in 1.0, 5.0, and 10.0 N sulfuric acid solutions showed that although the yields obtained were invariably higher than those predicted from the concentration ratios of ferrous ion to dissolved oxygen, no evidence was obtained to confirm the very high yields reported by Proskurnin and co-workers. The increase in yield observed was attributed to interference with the "primary" hydrogen yield by a mechanism involving electron or hydrogen atom capture by a ferrous ion-oxygen complex. (auth)

35876 EFFECT OF IONIZING RADIATION ON CRYSTALLINE CARBOHYDRATES. S. Dilli and J. L. Garnett (Univ. of New South Wales, Sydney). Chem. Ind. (London), No. 10: 409-10(Mar. 9, 1963).

In a study of the mechanism of radiation-induced reactions with cellulose, the radiation chemistry of a number of simple crystalline sugars and polysaccharides was investigated. All solid sugars were irradiated in both air and vacuum to total doses of 10^7 and 10^8 rad in a Co^{60} source at 1.25 megarad/hr. Examination of the gaseous products showed that irradiated cellobiose yields a relatively high hydrogen content, while amylose and amylopectin (amorphous) at doses of 10^8 rads show the presence of no water vapor. The same gases were also reported to result from the irradiation of crystalline glucose. In the solid state, the majority of the saccharides showed marked color changes following irradiation. These colors, which were unchanged after 2 yr, varied from bright yellow with amylose, amylopectin, and glucose to dark brown with sucrose. Melibiose, lyxose, and fucose showed no change. Aqueous solutions of the irradiated materials were distinctly acid (pH 3-5). Paper chromatographic examination of the aqueous carbohydrate solutions showed no differences for the carbohydrates irradiated in air or vacuum. In marked contrast to the monosaccharides, the radiation stability of disaccharides was relatively poor. Each of the disaccharides tested yielded a large number of degradation products of which the component monosaccharides predominated. With the irradiated polysaccharides (amylose, amylopectin, and cellulose) characteristic chromatographic behavior in all solvents was a trail of reducing material often running to the end of the sheet. In the chromatography of all three compounds, only a faint spot corresponding to glucose was observed. Data are tabulated for the gas yields (H_2, CH_4, H_2O, CO, CO_2) and Rf values of the products from the irradiation of amylose, amylopectin, cellulose, trehalose, cellobiose, maltose, sucrose, lactose, and melibiose. (BBB)

35877 EXTRACTION OF HIGH SPECIFIC ACTIVITY CHROMIUM-51 FROM PILE-IRRADIATED POTASSIUM CHROMATE. R. S. Mani (Atomic Energy Establishment, Trombay, India). Intern. J. Appl. Radiation Isotopes, 14: 327-8(Aug. 1963). (In English)

Following in-pile irradiation of potassium chromate, the chromate in alkaline solution is passed through an alumina column, and the chromate is retained in the column, along with the pile-produced Cr^{51} activity. An acid washing of the column elutes all this activity, and drying of the acid solution yields Cr^{51} specific activities of 25 to 60 mC/mg. (T.F.H.)

35878 THE EFFECT OF pH AND MOLAL RATIO IN THE PREPARATION OF RADIOIODINE-LABELED THYROXINE AND 3,5,3′-TRI-IODOTHYRONINE. L. J. Anghileri (Volk Radiochemical Co., Skokie, Ill.). Intern. J. Appl. Radiation Isotopes, 14: 328-30(Aug. 1963). (In English)

The effects of variations of pH and molal ratios are studied in the preparation of iodine-131-labeled thyroxine by exchange and in the preparation of iodine-131-labeled 3,3′,5-triiodothyronine by exchange and by direct iodination of 3,5-diiodothyronine. A procedure is developed for analytical chromatographic separations. (T.F.H.)

35879 PROTECTIVE EFFECT OF NITROUS OXIDE ON RADIATION-INDUCED DEGRADATION OF POLYISOBUTYLENE. Yoichi Okada (Bakelite Co., Ltd., Yokohama, Japan). J. Appl. Polymer Sci., 7: 1791-6(Sept. 1963).

Polyisobutylene was irradiated by γ rays from a Co^{60} source in vacuum and in nitrous oxide atmosphere. The irradiated specimens in N_2O were damaged to a lesser extent than those in vacuum. Irradiated specimens were dissolved in CCl_4 and their viscosity was measured at 30°C. A plot of reciprocal of viscosity-average molecular weight against dose gave a straight line in each case for specimens irradiated in vacuum and in N_2O. Moreover, the presence of nitrous oxide reduced the extent of main-chain fracture to 63%. The degree of branching was nearly the same for all of the specimens, since Huggins' constant k′ was constant (k′ = 0.40) throughout the experiments. It can be concluded that the N_2O has a protective effect for main-chain fracture of polyisobutylene. (auth)

35880 INTERFEROMETRIC METHOD FOR DETERMINING THE DISTRIBUTION OF GRAFT CONCENTRATION IN RADIATION-INDUCED GRAFT COPOLYMER. H. Matsuo, K. Iino, and M. Kondo (Nippon Telegraph and Telephone Public Corp., Tokyo). J. Appl. Polymer Sci., 7: 1833-52(Sept. 1963).

Microinterferometry was applied as a quantitative method for determining the transversal distribution of graft concentration instead of the usual determination of an overall graft concentration of the radioinduced polypropylene–styrene graft copolymer. Since polystyrene has a higher refractive index than polypropylene, the fea-

tures of the interference fringe provide direct visualization of the distribution curve of graft concentration. The application of the method clarified the effects of radiation dose rate, film thickness, monomer concentration, temperature, and grafting technique on the graft composition. A retardative effect on grafting appeared in the vicinity of the surface when the grafting was performed in lower radiation field and with thinner film. This was explained by the variation in the grafting rate constant as a function of monomer concentration in the film. Furthermore, the post-irradiation effect and accelerative effect of methanol were followed. They acted effectively to form the surface, volumetric, and embedded grafts. The method also proved useful in routine examination for a qualitative estimate of the graft copolymer. (auth)

35881 THE EFFECTS OF ELECTRON RADIATION ON THE PROPERTIES OF ZIEGLER POLYETHYLENES. B. Wright (Petrochemicals Ltd., Manchester, Eng.). J. Appl. Polymer Sci., 7: 1905-18(Sept. 1963).

An investigation was made of the effects of electron radiation on the properties of stabilized Ziegler polyethylenes. Radiation was applied at dose levels of 0, 2, 5, 10, 25, 50, and 75 Mrad to polymers of various molecular weights and densities. The properties most affected were flow behavior and stress-cracking resistance. Radiation reduced the melt index of the polymers rapidly and no flow was observed at doses of 10 Mrad or more. A corresponding increase in environmental stress-cracking resistance was evident and in every case this property reached a value of 2000 hr at a dose of 10 Mrad. Changes in other properties were not very great until the radiation dose became large. At a dose of 50 Mrad, the softening point was increased on the average by 7°C., the yield strength was increased on the average by 140 psi, elongation was reduced to a common value of about 200%, and impact strength was increased to a common value of about 20 ft./lb./in. notch. Power factor rose to a maximum as the dose was increased to 10 Mrad and diminished at larger doses. Flex resistance, in the one case examined, diminished as radiation dose was increased. (auth)

35882 OPTICAL STUDIES OF ANISOTROPIC COLOR CENTERS IN GERMANIUM-DOPED QUARTZ. A. Halperin and J. E. Ralph (Mellon Inst., Pittsburgh). J. Chem. Phys., 39: 63-73(July 1, 1963).

The optical absorption induced by x rays in germanium-doped quartz was investigated using polarized light. The wavelength range was 220–800 mμ, and the behavior of the various bands was examined over the temperature range of 77–600°K. Absorption bands polarized in parallel to the optical axis were observed at 250, 285, 296, 450, and about 620 mμ, and bands at 260, 272, 290, and 330 mμ were found to be polarized perpendicularly to the optical axis. The experiments also included a study of the optical bleaching of the bands and the effects of exchange of interstitial monovalent ions by electrical diffusion. The results are discussed and correlated with other results of electron paramagnetic resonance measurements carried out on the same specimens. (auth)

35883 EPR STUDY OF IMPURITY-RELATED COLOR CENTERS IN GERMANIUM-DOPED QUARTZ. John H. Mackey, Jr. (Mellon Inst., Pittsburgh). J. Chem. Phys., 39: 74-83(July 1, 1963).

Studies were made on germanium-doped quartz containing an Na^+ or Li^+ ion after irradiation at 77°K by conventional methods of EPR spectroscopy (9500 Mc/sec) and a new set of low-temperature centers associated with the impurities was discovered. By identification of nuclear hfs and modification of the interstitial content through diffusion in an electric field, it was established that the same number of species is produced under these conditions but that the interstitial is located at the aluminum site. Detailed observations on the g tensors and hfs of the germanium centers are reported while observations on the aluminum centers are limited to the field orientation H‖c. By warming the crystals, efficient conversion of the low-temperature centers to the high-temperature forms is produced in crystals containing Na^+ and Li^+ for charge compensation. All low-temperature forms are bleached completely by warming in samples in which the alkali ions have been replaced by H^+, which is known to have a small mobility. While detailed models of all centers are not suggested, enough information was obtained to establish the relationship between the low- and high-temperature forms. The experiments are correlated with other optical results. (P.C.H.)

35884 DISSOCIATIVE IONIZATION OF CO BY ION IMPACT. Clayton F. Giese and William B. Maier II (Univ. of Chicago). J. Chem. Phys., 39: 197-200(July 1, 1963).

Cross sections for the reactions $He^+ + CO \rightarrow C^+ + O + He$, $Ne^+ + CO \rightarrow C^+ + O + Ne$, and $Ar^+ + CO \rightarrow C^+ + O + Ar$ were studied as functions of ion kinetic energy. The first reaction exhibits the behavior expected for an exothermic reaction. The latter two prove to be endothermic and to have onsets that are surprisingly sharp. The experimental thresholds are in good agreement with values calculated from the well-accepted D(CO) = 11.11 ev. It appears that the technique used may prove to be useful for determining unknown bond-dissociation energies. (auth)

35885 PARAMAGNETIC RESONANCE OF NITROGEN ATOMS IN X-RAY-IRRADIATED SODIUM AZIDE. Frederick F. Carlson (Army Engineer Research and Development Labs., Fort Belvoir, Va.). J. Chem. Phys., 39: 1206-10(Sept. 1, 1963).

Electron paramagnetic resonance studies of the fine structure of nitrogen atoms trapped in x-ray-irradiated sodium azide at low temperatures revealed that the atoms are trapped interstitially. There are three similar sites with magnetic axes parallel to the three axes of the rhombohedral unit cell. The data are fitted to an appropriate spin Hamiltonian, and the temperature dependence of the fine-structure parameters is discussed. (auth)

35886 CHEMISTRY OF POSITIVE IONS. III. THE RADIATION CHEMISTRY OF SOLID n-HEXANE AT 77°K. Larry Kevan and W. F. Libby (Univ. of California, Los Angeles). J. Chem. Phys., 39: 1288-97(Sept. 1, 1963).

The mechanism of the chemical effects of ionizing radiation on solid straight-chain saturated aliphatic hydrocarbons such as polyethylene was studied by use of n-hexane. This hydrocarbon was short enough to allow analysis of the cross-link C_{12} products and of the hexenes formed. It was thought to be long enough to serve as a legitimate substitute for polyethylene. In any case, the yields of H_2, olefines, and cross linkages were very similar in the two systems and it is believed that the mechanistic implications found here for solid n-hexane at 77°K should apply even to polyethylene. The results indicate: the active species is the original ion radical produced by the ionizing radiation (Co^{60} gammas); the ion radical reacts before relaxing to redistribute the positive charge or to isomerize in any way, and the products show that there are three primary ions formed corresponding to the first, second, and third carbon atoms in the chain; the ion radical reacts with nearest neighboring groups to bond and release H_2, thus forming olefines by reaction with neighboring C atoms in the same molecule

four times out of five, but reacting with neighboring chains to form C_{12} dimers one time out of five; the dimers being only the five hydrocarbons possible by close-neighbor interaction: the 1,1 interaction being n-dodecane; the 1,2 being 5-methylundecane; the 2,2 being 5,6-dimethyldecane; the 2,3 being 4-ethyl-5-methylnonane; the 3,3 being 4,5-diethyloctane and no others; the principal mechanism of the fast interaction of the primary ion is the direct elimination of H_2 and formation of a bond due to charge exchange attraction between the primary ion and the neutral group with which it interacts; the second most important mechanism is the abstraction of H to form the electronically saturated analog of CH_5^+ which when neutralized eliminates H_2 and leaves a free radical to combine with the neighboring free radical left by the H abstraction and free radicals seemed to play a minor role in the solid hydrocarbon, n-hexane. (auth)

35887 ELECTRON SPIN RESONANCE OF IRRADIATED KH_2PO_4 AND KD_2PO_4. W. E. Hughes and W. G. Moulton (Univ. of Alabama, University). J. Chem. Phys., 39: 1359-60(Sept. 1, 1963).

The electron spin resonance (ESR) spectra of single crystals of KH_2PO_4 and KD_2PO_4 irradiated with 50-kv x rays were studied. The data for the two compounds were found to be nearly the same, except that in the case of KD_2PO_4 the lines were narrower by a factor of 2, the total spectrum was slightly narrower, and a low-intensity almost isotropic doublet with a splitting of 29G was observed. The centers were stable at 77°K but were found to disappear after 30 min at 130 and 160°K for KH_2PO_4 and KD_2PO_4, respectively. (M.C.G.)

35888 RADIATION DECOMPOSITION OF AQUEOUS NITRITE SOLUTION CONTAINING MERCURIC SALTS. Kenichi Shinohara (Inst. of Physical and Chemical Research, Tokyo), Tadamasa Shida, and Nobufusa Saito. J. Chem. Phys., 39: 1470-4(Sept. 15, 1963).

Aqueous sodium nitrite solutions containing mercuric salts give mercurous salts when irradiated with Co^{60} γ rays. The G value of mercurous salt attains such a high value over a wide range of solute concentration that the accepted radical yields cannot account for it. In order to settle the apparent contradiction it is suggested that several excited water molecules may be produced and that they can react with nitrite ions to form excited complexes which can reduce mercuric into mercurous salt. (auth)

35889 INTERPRETATION OF ION YIELDS IN BINARY MIXTURES. Cornelius E. Klots (Florida State Univ., Tallahassee). J. Chem. Phys., 39: 1571-5(Sept. 15, 1963).

A formal interpretation of ion-yield measurements in binary gaseous mixtures is given in terms of net constituent stopping powers averaged throughout the prevailing degradation spectrum. Subsequent inelastic bimolecular collisions as a source of ionization are not considered. Previously observed regularities in ion yields are consistent with the notion of a typical degradation spectral distribution, a function only of the radiation source. "Deviations" from additive-mixture laws then stem from an oversimplified concept of additivity. An application to the energy-partition problem in radiation chemistry follows from the formalism. (auth)

35890 EFFECT OF ELECTRIC FIELD STRENGTH ON THE GAMMA-RADIATION-INDUCED CONDUCTANCE OF LIQUID ALKANES. G. R. Freeman (Univ. of Alberta, Edmonton). J. Chem. Phys., 39: 1580-6(Sept. 15, 1963).

The γ-radiation-induced conductance of liquid alkanes was studied as a function of electric field strength, irradiation dose rate, and temperature over wide ranges. The conductance at fields below about 10^2 V/cm seems to be governed by electrode processes, but is not understood. The conductance at fields between about 10^2 and 10^3 V/cm was explained earlier [G. R. Freeman, J. Chem. Phys. 39: 978 (1963)]. A theory developed by Onsager was extended to explain the results at fields greater than 10^3 V/cm. It appears that the number of electrons that escape their parent ions or spurs increases markedly with increasing field strength at high fields, but is nearly independent of temperature. (auth)

35891 DETERMINATION OF ELECTRONIC ENERGY LEVELS OF MOLECULES BY LOW-ENERGY ELECTRON-IMPACT SPECTROSCOPY. J. Arol Simpson and S. R. Mielczarek (National Bureau of Standards, Washington, D. C.). J. Chem. Phys., 39: 1606-7(Sept. 15, 1963).

Studies were made of the electron-impact spectra of helium and ethylene to determine whether deviations in measurements made previously by Kuppermann and Raff were a result of large-angle scattering or low energy. It was concluded that deviations from optical spectra observed by Kuppermann and Raff are a consequence of the high angular scattering rather than any marked deviation from the Born approximation at 50-ev primary energy. Results are shown in graphs. (M.C.G.)

35892 DIFFERENCES BETWEEN LOW-ENERGY ELECTRON-IMPACT SPECTRA AT 0° AND AT LARGE SCATTERING ANGLE. Aron Kuppermann and Lionel M. Raff (Univ. of Illinois, Urbana). J. Chem. Phys., 39: 1607-8(Sept. 15, 1963).

Measurements of electron-impact spectra of helium and ethylene were compared with results obtained by Simpson and Mielczarek. It was concluded that differences are due to differences in scattering angles and are not inconsistent with each other. The $1\,^1S \rightarrow 2\,^3S$ transition in helium was observed for 50-ev electrons and large scattering angles and it was therefore concluded that the Born approximation is wrong under those conditions. (M.C.G.)

35893 SEPARATION OF CARRIER-FREE YTTRIUM-90 FROM STRONTIUM-90: A RADIOCOLLOIDAL METHOD. Hwasheng Cheng (National Tsing Hua Univ., Hsinchu, Taiwan). J. Chinese Chem. Soc. (Taiwan), 7: 154-65(Dec. 1960).

Sr^{90} and Y^{90} were adsorbed on NH_4-form Dowex 50-X4 (50-100 mesh) columns and the radiocolloidal Y^{90} was eluted with ethanol or methanol. The NH_4 form was chosen because its basicity facilitates the formation of radiocolloids. Radiocolloids are not adsorbed on the resin whereas the ionic species are readily adsorbed. Max fractions of the radiocolloids (18% with ethanol and 7% with methanol) were eluted by 50% aqueous solutions of the organic solvents. The percentage of Y^{90} removed by ethanol solutions was higher than that by methanol solutions except when the 100% nonaqueous solvents were used. When no activity was present in the effluent solution, the column was scanned with a GM counter. It was observed that, in addition to the intense activity remaining at the top of the resin bed where Sr^{90} solution had been originally adsorbed, there was a wide distribution of activity over the resin bed. This suggested the fractional conversion of the ionic form to colloidal agglomerates and the anomalous adsorption of the latter on the resin, since it seems unlikely that the adsorption of radiocolloids on the resin particles was occurring. The anomalous adsorption was probably due to the formation of colloidal agglomerates which were growing in size and retained in the channels among the resin particles. The effect of adding the alcohols

to citric acid solution on the elution of Y^{90} was also studied. When the pH of solutions of citric acid and ethanol in the desired proportions were adjusted to 3.5 by ammonia, all the Y could be eluted, the distribution coefficient increased (~ twice as great as in citric acid solutions), and the elution curves were tailed; so that 15 or more column volumes of influent solutions were necessary for the complete elution. Thus the anomalously adsorbed agglomerates can be broken up by passing a complexing reagent such as citric acid of pH 3.5, although the destruction of agglomerates may be time consuming and tailing during elution may result. It seems that a longer column is associated with the effective removal of radiocolloid, but a shorter one provides sharper separation. (BBB)

35894 STUDIES ON THE PRODUCTION OF SULFUR-35 BY TRIGA MARK II RESEARCH REACTOR. PART I. RADIOCHEMICAL SEPARATION AND DISCUSSION. C. K. Kim (Atomic Energy Research Inst., Seoul, Korea). J. Nucl. Sci., 2: 35-6(1962). (In Korean)

Using 10 g of hexachlorobenzene for 20 hour continuous irradiation, about 2 ~ 3 mC of S^{35} can be produced by TRIGA Mark II research reactor when it begins operation. A neutron flux of about 0.7×10^{12} n cm^{-2} sec^{-1} at the rotary specimen rack and about 4.0×10^{12} n cm^{-2} sec^{-1} at the central thimble is obtainable. The neutron reaction proposed for the production is $Cl^{35}(n,p)S^{35}$. The proposed radiochemical separation gives a chemical yield of 90% in the form of sulfuric acid and a radiochemical purity of 99%. (auth)

35895 RADIATION INDUCED REACTION OF NITRIC OXIDE WITH CYCLOHEXANE. Stanislaw Ciborowski (Inst. of General Chemistry, Warsaw). J. Phys. Chem., 67: 1375-6(June 1963).

The formation of nitrosocyclohexane and its secondary reaction with nitric oxide were sought in the radioinduced reaction of nitric oxide with cyclohexane. Colorless crystals of adipic acid were found in the reaction mixture. No considerable amounts of cyclohexanone and cyclohexanone oxime were found. Infrared analysis showed the presence of both nitrocyclohexane and cyclohexyl nitrate in the reaction mixture. No nitrosocyclohexane was found. (M.C.G.)

35896 THE NEUTRON IRRADIATION OF A GRAPHITIZED CARBON BLACK. David Allan Cadenhead (State Univ. of New York, Buffalo). J. Phys. Chem., 67: 1398 (June 1963).

Sorption studies were carried out on samples of unirradiated and neutron-irradiated graphitized carbon black. Argon isotherms were determined at 77.4°K on an unirradiated sample and two irradiated samples. The results indicated that the surface remains essentially homogeneous as far as physical adsorption is concerned, but that a small decrease occurs in surface area. (M.C.G.)

35897 TEMPERATURE EFFECTS ON THE RATE OF RADIOINDUCED HYDROCARBON CONVERSIONS. A. M. Brodskii. Kinetika i Kataliz, 4: 337-47(May-June 1963). (In Russian)

Radioinduced conversion of liquid hydrocarbons was studied as a function of temperature. Experimental data are given on radiative-thermal cracking of petroleum hydrocarbons in a nuclear reactor, and the rate and direction of radiolysis at elevated temperatures are analyzed. (tr-auth)

35898 RADIOINDUCED REDOX CONVERSION OF ACCEPTORS IN ORGANIC SOLVENTS. II. CONVERSION OF COPPER COMPOUNDS IN ACETONE SOLUTIONS. M. Roder, N. A. Bakh, and L. T. Bugaenko (Moscow State Univ.). Kinetika i Kataliz, 4: 353-6(May-June 1963). (In Russian)

Studies of x-ray effects on $CuCl_2$ and Cu_2Cl_2 acetone solutions at 70 kev showed that in absence of oxygen the maximum yield in Cu(II) reduction to Cu(I) is 17.3 ± 0.5 ion/100 ev, without oxidation of Cu(I). In presence of oxygen Cu(I) was oxidized to Cu(II) with high yield. (R.V.J.)

35899 AN INSTALLATION FOR STUDYING CATALYTIC PROPERTIES DURING IRRADIATION IN REACTOR. I. Maksim, T. Braun, and P. Khaduk (Inst. of Nuclear Physics, Bucharest). Kinetika i Kataliz, 4: 475-9(May-June 1963). (In Russian)

A description is given of an installation for studying various catalytic reactions in gases catalyzed by solid catalysts. The installation placed in one of the horizontal channels in a 2000-kw WWR-C type reactor is capable of studying various oxide or sulfide powder, tablet, or foil-shaped catalyzers. (R.V.J.)

35900 GAS CHROMATOGRAPHY AND ELECTRON PARAMAGNETIC RESONANCE STUDIES OF RADIOLYSIS OF CERTAIN HYDROCARBONS. Z. V. Pshibylovich, V. A. Krongauz, and Kh. S. Bagdasar'yan (Karpov Inst. of Physics and Chemistry, USSR). Kinetika i Kataliz, 4: 489-91 (May-June 1963). (In Russian)

Radiolysis yields of n-octane, n-octylbenzene, and equimolar octane-benzene products were determined and tabulated. Electron paramagnetic resonance spectra in the examined systems during irradiation in frozen state were also determined. (R.V.J.)

35901 PREPARATION OF CARRIER-FREE RADIOACTIVE ATOMIC PRODUCTS BY ELECTROCHROMATOGRAPHIC METHODS USING AN ANODIC POLARISED PLATINUM POWDER COLUMN. I. Mádi. Magy. Kem. Folyoirat, 68: 129-37(1962).

Electrolytic separation of radioactive ions (Ce^{144}, Pr^{144}, Y^{90}, Yb^{175}) using asymmetrical electrode systems was investigated on a platinum anode. From measurements on the oxide produced by a single kind of ion, it was established that at best, only one monomolecular surface layer can evolve at the anode. It was further found from distribution coefficients that the platinum activation surface changes with pH values. On the basis of research results a chromatographic process with electrolysis was used for separating carrier-free radioactive atoms. A chromatogram was attained only with the help of a polarized platinum powder anode. For example, the separation of Sr^{90}, Y^{90}, Pr^{144}, and Ce^{144} was accomplished from dilute solutions of nitrohydrochloric acid. (Atomdokumentation, 4 No. 15, Dec. 1962)

35902 RADIATION YIELD OF CITRACONIC AND MESACONIC ACIDS IN AQUEOUS SOLUTION. A. L. Fantola, E. Lazzarini, and A. Piscitelli (Centro Studi Nucleari E. Fermi Politecnico, Milan). Nature, 199: 594-5(Aug. 10, 1963).

Experiments were carried out to ascertain whether the double-bond radiolability of citraconic acid is different from that of its isomer mesaconic acid in aqueous solution. Solutions of mesaconic and citraconic acids of various molarities were irradiated with Co^{60} γ radiation at various levels. The number of events for every 100 ev absorbed were calculated at every concentration by the least-squares method from the initial slope of the plot of the number of molecules destroyed against absorbed ev. The radiation yields increased for both compounds with the concentrations of solutions to almost a saturation value. It was shown that the radiation yields of the two isomers are different. Results are

compared with previously obtained values for fumaric and maleic acids. It was concluded that a steric factor plays a part in the double-bond stability of γ-irradiated solutions of fumaric, maleic, citraconic, and mesaconic acids. (C.H.)

35903 STABILITY OF THYMIDINE LABELLED WITH TRITIUM OR CARBON-14. E. Anthony Evans and F. G. Stanford (Radiochemical Center, Amersham, Buckinghamshire, Eng.). Nature, 199: 762-5(Aug. 24, 1963).

Data are presented on the stability of thymidine labeled with tritium or C^{14} under various storage conditions. Data are included on the effect of γ radiation on solutions of tritiated and C^{14}-labeled thymidine and on freeze-dried tritiated thymidine. (C.H.)

35904 SOLVATED ELECTRONS IN ALKALI GLASSES. M. J. Blandamer, L. Shields, and M. C. R. Symons (Univ. of Leicester, Eng.). Nature, 199: 902-3(Aug. 31, 1963).

Work by Jortner and Sharf indicate absorption in frozen aqueous solutions of alkali metal hydroxides at 17,000 cm^{-1} after exposure to 200 kv x rays. A model is proposed that attributes the reaction observed by Jortner and Sharf to trapping of electrons as in F-centers to give the required solvated center. An investigation of frozen aqueous alkali metal hydroxide systems by visible and electron spin resonance was undertaken, and results seem to support the model. (H.M.G.)

35905 ELECTRON SPIN RESONANCE OF FREE RADICALS FORMED IN AMYLOSE BY γ IRRADIATION. Akira Mishina (Osaka Univ.). Nippon Nogei Kagaku Kaishi, 36: 620-3(1962).

Electron spin resonance (ESR) spectra were determined for three preparations of amylose irradiated at a dose rate of 10^5 r/hr with Co^{60} γ rays to total doses of 1.8×10^7 r at room temperature in vacuo. The starting materials were amylose with a helical structure, deuterated amylose, and heated amylose (lacking a helical structure). The concentration of the free radicals produced by irradiation was determined by comparison of the ESR spectra with that of a known quantity of α,α-diphenylpicrylhydrazine. The ESR tracings changed their shape and height during the storage of the specimens at room temperature after irradiation. These results indicated that γ-irradiated amylose having the helical structure contains two or more kinds of free radicals having different lives at room temperature. Different spectra were obtained for deuterated amylose. If the spectra reflect only related R-O · radicals, no significant difference would be expected between deuterated amylose and amylose having the helical structure. Therefore, the principal difference between these spectra would be based on the altered interaction between an unpaired electron of the α-carbon atom and hydrogen or deuterium of hydroxyl groups. X-ray-diffraction patterns showed that the crystalline helical structure of the amylose was damaged by the heat treatment during deuteration. These results suggest that the crystalline helical structure of amylose acts as a radical trap. Previous ESR studies on uv-irradiated amylose in the presence of H_2O_2 at −195°C showed a spectra consisting of a triple-line which disappeared immediately when the samples were brought to −130°C. An identical spectrum was obtained in the case of deuterated amylose, indicating that different species of free radicals were formed between γ- and uv-irradiated amyloses. (TCO)

35906 PRIMARY PROCESSES OF RADIATION CHEMISTRY AS STUDIED BY MASS SPECTROMETRY. I. FRAGMENTATION OF TETRAHYDRONAPHTHALENE ON ELECTRON IMPACT. Zbigniew Kecki and Henryk Wincel (Inst. of Nuclear Research, Polish Academy of Sciences, Warsaw). Nukleonika, 8: 117-27(1963). (In English)

Mass spectrum of tetrahydronaphthalene was registered. On the basis of the apparent masses of metastable ions, a scheme of tetrahydronaphthalene molecular fragmentation occurring under electron impact was established. Great abundances of $C_nH_n^+$ ions were observed. The $C_8H_8^+$ and $C_7H_7^+$ ions have a cyclic form and decompose in a similar way as the same ions originating from different organic substances. (auth)

35907 RELEASE OF TRITIUM FROM NEUTRON-IRRADIATED LITHIUM SALTS. C. Mantescu and T. Costea (Inst. of Atomic Physics, Bucharest). Phys. Status Solidi, 3: K290-3(1963). (In English)

Preliminary results are reported on the thermal release of tritium from reactor-irradiated crystalline lithium salts. Irradiated samples were submitted to heat treatments at constant temperature in an electrically heated quartz furnace. The free tritium was separated from the bonded tritium by measuring the activity of uncondensable and condensable gases at liquid nitrogen temperature. By dissolving the heated samples in various solvents, it was established that the bulk of the activity was still trapped in the crystal. (M.C.G.)

35908 GROWTH AND BLEACHING OF THE Z_1 BAND IN KCl DOPED WITH DIVALENT IMPURITIES. R. Cappelletti, L. Dalla Croce, and R. Fieschi (Università, Milan and Istituto Nazionale di Fisica Nucleare, Milan). Phys. Status Solidi, 3: 1347-57(1963). (In English)

The rate of F and Z_1 center formation by x-irradiation was studied at different temperatures in doped KCl crystals; at 0°C and at room temperature the slow but fully reproducible, growth of a Z_1 band was found, but this attained only a low saturation value. The results can be interpreted by assuming that the x rays have an additional bleaching effect which is stronger for the Z_1 than the F centers. The effects of free holes in the valence band (obtained by optical stimulation of V centers) on these centers were also studied at different temperatures, and the ratio of the capture cross sections for holes, σ_Z^h/σ_F^h was determined, the values ranging from 2.1 (at liquid nitrogen temperature) to 1.5 (at room temperature). (auth)

35909 THE FORMATION OF ABNORMAL VALENCY STATES IN THE RADIOLYSIS OF AQUEOUS METAL-ION SOLUTIONS. G. E. Adams, J. H. Baxendale, and J. W. Boag (Mount Vernon Hospital, Northwood, Eng. and Manchester Univ., Eng.). Proc. Chem. Soc., 241-2(Aug. 1963).

Solutions of Zn^{2+}, Cd^{2+}, Co^{2+}, and Mn^{2+} in deaerated 0.1 M aqueous methanol were irradiated by a 2 μsec pulse of 2-Mev electrons from a linear accelerator. No absorption was produced in the same conditions by 0.1 M methanol in the absence of the metal ions, and change from 0.1 to 10^{-3} M methanol had no effect on the spectrum given by Zn^{2+} solutions. The absorption maximum for Zn^{2+}, at 3000 Å decreases according to second-order kinetics but after it has disappeared (100 μsec) there is still considerable absorption below 2700 Å. The presence of 10^{-2} N sulfuric acid decreases considerably the absorption at 3000 Å. Thus at short delay times the absorption spectrum of the solution is a composite of those of Zn^+ and Zn^0, the latter being responsible for the rising absorption at lower wavelengths. In 10^{-2} N acid this component is absent since Zn^+ is oxidized back to Zn^2 by H^+, and Zn^0 is not formed. (P.C.H.)

35910 THE EFFECT OF CUPRIC AND THALLOUS IONS ON THE RADIOLYSIS OF AQUEOUS SOLUTIONS OF

ETHYLENEDIAMINE, PROPANE-1,2-DIAMINE, AND GLYCINE. M. Anbar (Weizmann Inst. of Science, Rehovoth, Israel) and P. Rona. Proc. Chem. Soc., 244-6(Aug. 1963).

Oxygen-saturated solutions of ethylenediamine, propane-1,2-diamine, and glycine in triply distilled water were irradiated with Co^{60} gamma rays at a dose rate of 12400 rad/min, with total doses of 100,000 to 150,000 rads. Thallous or cupric sulfate in dilute aqueous solutions was found to induce radiolysis in the presence of scavengers, which otherwise completely inhibit their decomposition. Organic scavengers inhibited radiolysis completely in propane-1,3-diamine and in butane-1,4-diamine solutions in the presence of thallous sulfate. Cupric sulfate had no effect on the radiolysis of ethylenediamine solutions saturated with nitrous oxide, in the presence or absence of scavengers. It is suggested that cupric ions act by reduction to Cu^{+} since they have no effect under nitrous oxide. Thallous ion, on the other hand, may act via the Tl^{2+} state, formed by their reaction with OH radicals. (P.C.H.)

35911 BEHAVIOR OF Fe(III) SOLUTIONS IN 0.8N H_2SO_4 AT A RADIOACTIVE ELECTRODE. Loris Busulini and Paola Ciriello (Università, Padua; Università, Bologna; CNR, Padua; and CNEN, Padua). Ric. Sci., Rend., 3: 675-80(July 1963). (In Italian)

The behavior of iron(III) solutions in 0.8N H_2SO_4 at a Pt electrode which works at the same time as an α source and as an indicator of their effects is described. The observed phenomena, which happen at high free-radical concentrations, are explained. (auth)

35912 THE EFFECTS OF X RADIATION ON THE UV ABSORPTION SPECTRA OF DNA SOLUTIONS. Lothar Rossberg (Max-Planck-Institut für Biophysik, Frankfurt am Main). Strahlentherapie, 121: 443-9(July 1963). (In German)

The effect of x rays and uv light on the absorption spectrum of deoxyribonucleic acid (DNA) solutions was investigated using different ionic strength of the solvent. There was an inhibition of the indirect radiation effect by x rays if the DNA was dissolved in NaCl solution instead of in distilled water. (auth)

35913 THE EPR SPECTRUM OF γ-IRRADIATED POLYMETHYL METHACRYLATE SPECIFICALLY DEUTERATED IN THE METHYLENE GROUP. P. Kourim and K. Vacek (Nuclear Research Inst., Czechoslovak Academy of Sciences, Prague). Tetrahedron Letters, No. 23, 1051-3(Nov. 1962).

Polymethyl methacrylate (PMMA) on exposure to ionizing radiations gives an EPR spectrum identical to the one obtained on polymerizing methyl methacrylate (MMA) and trapping free radicals in the polymer gel. To clarify the nonequivalence of interaction of protons with the unpaired electron in the free radical concerned, MMA was synthesized, specifically deuterated in the methylene group. The infrared spectra of normal and deuterated MMA show the specificity and the practically quantitative degree of deuteration. The absorption band at 3010 cm^{-1}, assigned to the stretching vibration C–H of $=CH_2$ group, and other bands due to deformation vibrations C–H of the same group in the regions 1410, 660, and 600 cm^{-1}, disappear in the spectrum of deuterated MMA and a new band due to C–D stretching vibration appears at 2230 cm^{-1}. Absorption bands of stretching and deformation vibrations C–H of $-CH_3$ groups remain unchanged. The monomer thus obtained was block polymerized at 60°C during 400 min with dibenzoyl peroxide as initiator (36 mmole/l) and then γ-irradiated with a dose of 2.64×10^{18} ev/ml at a rate of 11.7×10^{16} ev/min/ml by a Co^{60} source. The EPR spectra of normal and deuterated PMMA, polymerized and irradiated at identical conditions, show unequivocally the interaction equivalence of the methyl protons, that gives evidence of the correctness of the Ingram hypothesis of free rotation of the methyl group around the C–C bond with a frequency higher than 10^{7} rev/sec. The interaction with one deuteron broadens the spectral lines; the broadening at max slope amounts to 4 ± 2 gauss. The quartet in the EPR spectrum of normal PMMA arises from the interaction with the methyl protons only. Should this quartet originate from an interaction with two protons of the methyl group and one proton of the methylene group, there would have to be a weaker triplet superimposed upon the quartet in the EPR spectrum of deuterated PMMA; this is, however, not the case. Therefore, the quartet of normal PMMA probably arises in such a conformation of the macroradical where the axis of the unpaired electron orbital just halves the angle between the methylene C–H bonds. (BBB)

35914 PROTECTION BY BENZENE IN THE RADIOLYSIS OF CYCLOHEXANE. Gisuke Meshitsuka, Fukuo Takemura, Tokuji Sakai, and Kozo Hirota. Tokyo Metropolitan Isotope Centre Ann. Rept., 1: 61-6(1962). (In English)

Yields of atomic hydrogen from the radiolysis of cyclohexane-benzene mixtures by Co^{60} γ rays were measured using an iodine scavenger technique. Benzene affects the production of atomic hydrogen from cyclohexane by an energy transfer mechanism. The ratio of the rate constant for transfer of excitation to benzene from an excited cyclohexane to the rate constant of the reaction of such an excited species by the process that ultimately yields HI, was estimated to be 0.31 M^{-1}. From examination of previous data, the ratio of the rate constant for transfer of excitation to benzene to the rate constant for the reaction of an excited cyclohexane that ultimately yields hydrogen by a process frequently assumed to be molecular, is calculated to be 0.65 M^{-1}. It was concluded that the effect of benzene on the yield of hydrogen from a cyclohexane-benzene mixture is due to the energy transfer and hydrogen atom scavenging. (auth)

35915 HOT SYNTHESIS OF COMPOUNDS LABELED WITH RADIOACTIVE TRITIUM. An. N. Nesmeyanov and V. V. Pozdeev (Moscow State Univ.). Usp. Khim., 32: 773-99(July 1963). (In Russian)

T may be conveniently obtained by the $Li^{6}(n,\alpha)T$ and the He(n,p)T reactions. The T recoil atoms from the first reaction possess an energy of 2.73 Mev and a free path of about 50 microns in the condensed phase. Chemical reactions become possible at recoil energy levels at which they are able to form after collision a stable bond with some of the atoms of the molecule. It is reported in the literature that from 10 to 50% of the tritium atoms form a parent-labeled compound; 30 to 50% are obtained as the HT molecule while 5 to 25% form simpler or more complex compounds than the parent compound. The starting material, the conditions of irradiation, and the subsequent treatment must be individually determined. One of the products of the hot atoms is the labeled, low-intensity parent compound. The radiolytic action of the recoil atoms must be taken into account for the determination of the optimum irradiation period. A large portion of the products consists of substitution products, involving the replacement of N, halides, C_2H_5 groups, etc. by T and C^{14}. The latter forms preferentially high-boiling polymers, while the T tends to play an important role in the gas phase. Additions which react

chemically with the labeled compounds reduce their yield as a result of the secondary thermal reactions; on the other hand, materials which under the irradiation conditions used form fragments which participate in the formation of the labeled compounds tend to increase the yield. (56 references) (TTT)

35916 PRODUCTS OF RADIOLYSIS AND RADIATION OXIDATION OF ACETONE. P. Drienovskii and N. A. Bakh. Vestn. Mosk. Univ., Ser. II, Khim., No. 2, 28-31 (Mar.-Apr. 1963). (In Russian)

Data are presented on liquid-phase products prepared by irradiation of oxygen- and hydrogen-saturated acetones with doses from 1.5×10^{16} to 1.6×10^{16} ev/cm sec. Formation of acetylacetone and formaldehyde in presence and absence of oxygen and potentiometric titration of acetone in presence or absence of oxygen were analyzed. (R.V.J.)

35917 STUDIES OF OPTICAL FLASH AND OPTICAL QUENCHING OF PHOSPHOR CRYSTALS. V. L. Levshin and B. M. Orlov. Vestn. Mosk. Univ., Ser. III, Fiz. Astron., No. 3, 48-54(May-June 1963). (In Russian)

ZnS-phosphor luminescence is the result of secondary phosphorescence. The secondary phosphorescence appears after infrared light disappears. The luminescence develops during 10^{-5} to 10^{-3} sec, depending on the temperature. The thermal activation of optical flash in ZnS is 1.5 to 2 fold stronger than optical quenching. (tr-auth)

35918 MAN-MADE TRANSURANIUM ELEMENTS. Glenn T. Seaborg. Foundations of Modern General Chemistry Series. Englewood Cliffs, N. J., Prentice-Hall, Inc., 1963. 128p. $1.50 Paper; $3.95 Cloth.

A chronological and comprehensive survey is given of each of the eleven transuranium elements discovered before 1963. These include: Np, Pu, Am, Cm, Bk, Cf, Es, Fm, Md, No, and Lu. The position of these elements in the Periodic Table, the experimental methods of chemical investigation used in their discovery and study, the prospects for future transuranium elements, and the present and future applications of the transuranium elements are discussed. A detailed account of the chemical and physical parameters of the actinide elements (electronic structure, chemical and physical properties, and nuclear properties) is given. The sources of these elements are described. (M.C.G.)

35919 CHEMISTRY RESEARCH AND CHEMICAL TECHNIQUES BASED ON RESEARCH REACTORS. Report of a Panel on Chemistry Research Using Research Reactors Held in Vienna, From 4-8 March 1963. (International Atomic Energy Agency, Vienna). Technical Reports Series No. 17. 1963. 264p. (STI/DOC/10/17). $6.00; Sch 126; 36s.stg; NF 24; DM 21(IAEA).

Fourteen papers presented at a Panel on Chemistry Research using Nuclear Reactors are given. Separate abstracts were prepared for 10 of the papers. Four papers were previously abstracted for NSA. (M.C.G.)

35920 CHEMISTRY AND THE RESEARCH REACTOR. W. W. Meinke (Univ. of Michigan, Ann Arbor). p.17-59 of "Chemistry Research and Chemical Techniques Based on Research Reactors." Vienna, International Atomic Energy Agency, 1963. (In English)

The chemistry program at a reactor center is discussed. The current status of research-reactor utilization is summarized primarily from the standpoint of facilities and experimental techniques, but some typical examples of different uses in chemistry areas are presented. (auth)

35921 NUCLEAR CHARGE AND MASS DISTRIBUTIONS IN LOW-ENERGY FISSION. M. Talât-Erben (Nuclear Research and Training Centre, Istanbul). p.61-72 of "Chemistry Research and Chemical Techniques Based on Research Reactors." Vienna, International Atomic Energy Agency, 1963. (In English)

The chemistry of nuclear fission based on a nuclear reactor is reviewed and the areas needing further exploration are pointed out. These areas include a search for unknown short-lived nuclides of certain fission products, a determination of accurate fission yield, and an accumulation of more experimental data on fission processes, especially for fissionable materials other than U^{235}. (auth)

35922 RAPID RADIOCHEMICAL TECHNIQUES FOR THE STUDY OF NUCLEAR PROCESSES. S. Amiel and E. Yellin (Israel Atomic Energy Commission, Soreq Research Establishment, Rehovoth). p.83-93 of "Chemistry Research and Chemical Techniques Based on Research Reactors." Vienna, International Atomic Energy Agency, 1963. (In English)

Some of the very rapid radiochemical separation techniques used in research reactors are discussed, with emphasis on instantaneous and continuous flow methods. (auth)

35923 HOT-ATOM CHEMISTRY: FUNDAMENTAL STUDIES OF REACTION MECHANISMS. F. S. Rowland (Univ. of Kansas, Lawrence). p.137-47 of "Chemistry Research and Chemical Techniques Based on Research Reactors." Vienna, International Atomic Energy Agency, 1963. (In English)

The fundamental mechanisms of "hot" atom reactions, experimental techniques for practical applications, and some typical examples of hot-atom chemistry research which illustrate the current trend in research and the types of problems involved are described. (auth)

35924 SYNTHESIS OF LABELLED ORGANIC COMPOUNDS BY THE RECOIL NUCLEUS METHOD AND RADIATION SYNTHESIS USING A REACTOR AS THE NEUTRON AND NUCLEAR RADIATION SOURCE. A. N. Nesmeyanov. p.169-82 of "Chemistry Research and Chemical Techniques Based on Research Reactors." Vienna, International Atomic Energy Agency, 1963. (In Russian)

Research on synthesis based on the action of recoil nuclei, a "hot" synthesis, and radiation synthesis of labeled compounds was undertaken. Work on "hot" synthesis, which includes the labeling with C^{14}, tritium, halogens, S^{35}, N^{13}, and labelled metal-organic compounds, is summarized. (auth)

35925 THE NUCLEAR REACTOR AS A RADIATION SOURCE. J. K. Linacre and J. Wright (Atomic Energy Research Establishment, Harwell, Berks, Eng.). p.183-98 of "Chemistry Research and Chemical Techniques Based on Research Reactors." Vienna, International Atomic Energy Agency, 1963. (In English)

Most uses of nuclear reactors as a radiation source are linked in some way to reactor technological problems. A recent trend in experimental techniques used to study the chemistry of reactor materials and to study radiochemistry with the aid of reactors is discussed. A comparison of the effects of different types of radiation, the influence of radiation on the subsequent thermal reactions of solids, and a dosimetry of mixed radiation sources are discussed as examples for promising fields of study. (auth)

35926 NUCLEO-CHEMICAL REACTORS. P. Lévêque (Centre d'Etudes Nucléaires, Saclay, France). p.199-206

of "Chemistry Research and Chemical Techniques Based on Research Reactors." Vienna, International Atomic Energy Agency, 1963. (In French)

Energies provided by a reactor have already been applied to chemical systems for the production of chemicals, notably kinetic energy of fission fragments, which occupies a primary part in the total energy of fission, and gamma energies. The current status of the application of nuclear reactors to the production of chemicals is reviewed and some typical examples, such as nitric acid and hydrazine synthesis, are described. (auth)

35927 USING A RESEARCH REACTOR TO PREPARE SHORT-LIVED RADIOISOTOPES. R. Henry (Centre d'Etudes Nucléaires, Saclay, France). p.207-30 of "Chemistry Research and Chemical Techniques Based on Research Reactors." Vienna, International Atomic Energy Agency, 1963. (In French)

After an examination of the practical irradiation possibilities offered by a research reactor, particularly in relation to its operational program, the radioisotopes which it is useful to produce and those which can be produced are reviewed. The possibilities of applied research and development that the production of radioisotopes offers are discussed. (auth)

35928 PRODUCTION OF SHORT-LIVED ISOTOPES. I. Kiss (Central Research Inst. of Physics, Budapest). p.231-52 of "Chemistry Research and Chemical Techniques Based on Research Reactors." Vienna, International Atomic Energy Agency, 1963. (In English)

A survey of the production and purification methods of radioisotopes, problems encountered, and the trend of the present research activities on short-lived isotopes, in particular those suitable for practical applications, is presented. (auth)

35929 GENERAL AREAS NEEDING CHEMICAL COMPETENCE TO SUPPORT REACTOR OPERATION. E. Proksch and H. Bildstein (Osterreichische Studiengesellschaft fur Atomenergie, Vienna and Institut fur Chemie des Reaktorzentrums Seibersdorf, Austria). p.253-61 of "Chemistry Research and Chemical Techniques Based on Research Reactors." Vienna, International Atomic Energy Agency, 1963. (In English)

Chemical competence is needed not only for the development of new types of reactors but also for the startup and safe operation of reactors. The activities of chemistry and chemical engineering cover a number of fields, namely chemical analysis, radiochemical analysis, corrosion research, radiolysis of water, and water purification. Fields in reactor operation and maintenance in which chemical competence is needed are reviewed. (auth)

35930 LET EFFECTS IN THE RADIOLYSIS OF BENZENE AND O-TERPHENYL. J. Y. Yang, J. D. Strong, and J. G. Burr (Atomics International, Canoga Park, Calif.). 12p. (CONF-14-36)

From American Chemical Society 144th National Meeting, Los Angeles, Mar. 1963.

Benzene and o-terphenyl were irradiated with Po^{210}. The decomposition of the terphenyl is not zero order, since corrected values of G(-terphenyl) do not give a horizontal line. The values of G(-terphenyl) decrease sharply at even low polymer contents, indicating a pronounced inhibitory effect of polymer on terphenyl decomposition. Values of G(-benzene) were found to be 1.37 at 25°C and 1.43 at 35°C; total damage in each case was less than 1%. The polymer yield from benzene irradiated in the gas phase with tritium beta particles (5 kev average energy, LET in gas phase unknown) is 5.0. (P.C.H.)

Raw Materials and Feed Materials

35931 (NLCO-885) SUMMARY TECHNICAL REPORT [ON FEED MATERIALS] FOR THE PERIOD APRIL 1, 1963 TO JUNE 30, 1963. R. Burgett ed. (National Lead Co. of Ohio, Cincinnati). July 18, 1963. Contract AT(30-1)-1156. 48p.

Use of Lithium alloy to Shorten Bomb Reduction Firing Time. Plant-scale bomb reductions using UF_4 and Mg were initiated by Li pellets. The firing time was shortened appreciably, in one case from 250 to 135 min. There were no adverse effects on the yield, and the quantity of Li in the derby was negligible. High-Temperature Decomposition of Uranium Mononitride. A vaporization study of UN was conducted at 1600 to 2000°C, and the enthalpy of decomposition was determined to be 68.7 kcal/mole. Gamma-Phase Annealing of Uranium Containing Phosphorus. U metal containing 400 ppm P was annealed for 6 hr at 927°C and analyzed with an electron microprobe before and after the anneal. The phosphide inclusions were found to be completely stable. Recrystallization of Uranium Containing Small Additions of Iron and Silicon. Structures of partially recrystallized alpha-rolled U containing dilute alloys of Fe and Si were studied in the high alpha range and in the beta range. Recovery of Uranium by the Precipitation of Uranyl Ammonium Sulfite. Uranyl ammonium sulfite was precipitated from Scrap Recovery Plant leach liquor by NH_4OH and $(NH_4)_2SO_3$. The product can be calcined to U_3O_8 and used as a source for UF_4 prepared by the Winlo process. (D.L.C.)

35932 CHEMICAL PROCESSING OF URANIUM ORES. E. T. Pinkney, W. Lurie, and P. C. N. van Zyl (Anglo-American Corp. of South Africa Ltd., Johannesburg). Rev. Ser., Intern. At. Energy Agency, No. 23/24, 9-77(1962). (In English)

A short outline of the mineralogy of uranium is given and the physical concentration of uranium ores is reviewed. The main steps in the extraction of uranium from ores are listed, covering the chemistry as well as the technology of the processes. Three typical plants in existence are described and the respective flow-sheets given. The economics of three different hypothetical plants are analyzed and the relative economic merits of ion exchange and solvent extraction in uranium extraction evaluated. (auth)

35933 PROCESSING OF MINERAL ORES. L. G. Jodra and J. M. Josa (Junta de Energia Nuclear, Spain). Rev. Ser., Intern. At. Energy Agency, No. 23/24, 79-133 (1962). (In Spanish)

Aspects of uranium-ore reduction from the preparation of the ores to the production of the concentrate are discussed. Causes and reasons are given rather than details. Preliminary concentration, roasting in connection with the elimination of impurities, and the formation of soluble compounds are considered along with stockage, trituration, sampling, and grinding. Acid or alkaline lixiviation is dealt with in detail as being the key stage in the chemical processing. In the solid-liquid separation great importance is attached to the use and mode of operation of flocculants. In the recovery of uranium from the lixiviation solutions the direct precipitation method and the use of ion-exchange resins and organic solvents are analyzed. Finally, the precipitation of the concentrate from the ion-exchange eluates and re-extraction solutions is dealt with on the

basis of the impurities present and the specifications required of the concentrate: a description follows of the final procedures involved in preparing the analyzed material and getting it ready for delivery. The bibliography has 158 references to the end of 1960. (auth)

Separation Processes

35934 (AAEC/TM-187) SEPARATION OF BERYLLIUM FROM FISSION PRODUCTS IN A NITRATE MEDIUM — PRELIMINARY EXPERIMENTS USING SOLVENT EXTRACTION. J. Aggett (Australia. Atomic Energy Commission Research Establishment, Lucas Heights, New South Wales). Mar. 1963. Amended July 1963. 9p.

Preliminary experiments using acetylacetone in the presence of ethylenediaminetetraacetic acid to separate major quantities of beryllium from fission products are reported. Using 2M beryllium solutions, decontamination factors of the order of 10^3 were obtained with trace quantities of the more important fission products. This is sufficiently encouraging for the work to be repeated at higher activity levels. (auth)

35935 (AAEC/TM-210) SOLVENT EXTRACTION PROCESSES FOR THE RECOVERY AND SEPARATION OF URANIUM AND THORIUM. A Literature Survey. P. G. Alfredson and M. S. Farrell (Australia. Atomic Energy Commission Research Establishment, Lucas Heights, New South Wales). Aug. 1963. 19p.

A summary of the available literature on the development of the various processes for the separation of uranium and thorium from aqueous nitrate solutions is presented. Flowsheets are given corresponding to the various stages in the development of the Thorex processes. Thirty-seven references are included. (auth)

35936 (CONF-187-1) A FACILITY FOR THE PRODUCTION OF Pu^{238}. R. N. Tetzlaff (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). [July 1963]. Contract AT(07-2)-1. 16p.

For Presentation at American Nuclear Society Meeting, New York, Nov. 1963.

A pilot plant facility for recovering Pu^{238} and unconverted neptunium from irradiated neptunium target elements was operated for 17 months at the Savannah River Laboratory. The process required that the irradiated target elements be dissolved and the solution be processed through three anion exchange cycles for removal of undesirable fission products and cations, recovery of unconverted neptunium, and concentration of the Pu^{238} solution. The process equipment was enclosed in three stainless steel boxes that were installed in two general-purpose cells of a ten-cell complex. The basic cells were not modified. The two cells were not separated from the adjacent 8 cells. Containment of the high-specific-activity alpha emitters was accomplished by ventilation, development of handling techniques, use of procedures, and close radiation control coverage. The facility was dismantled, and the cells were decontaminated and returned to normal use. With the exception of an accidental overexposure, all personnel exposures were kept below the administrative level of 3 r/yr. None of the personnel assimilated detectable amounts of the material handled. (auth)

35937 (IS-284) GEM-BIS(DISUBSTITUTEDPHOSPHINYL)ALKANES. II. EXTRACTION PROPERTIES OF BIS(DI-N-HEXYLPHOSPHINYL)METHANE. Keith E. Burke, Hiroshi Sakurai, Jerome W. O'Laughlin, and Charles V. Banks (Ames Lab., Ames, Iowa). [Apr. 11, 1961]. Contract [W-7405-eng-82]. 20p.

Bis(di-n-hexylphosphinyl)methane, HDPM, $[(C_6H_{13})_2P(O)]_2CH_2$, was studied as an extractant for a variety of metals. HDPM was evaluated as an extractant for uranium(VI) and compared with tri-n-octylphosphine oxide, TOPO, $(C_8H_{13})_3PO$. In nonpolar solvents, HDPM forms a polymeric-like substance with compounds of uranium(VI). Viscosity measurements indicate that the molecular weight of the polymeric-like substance is about 100 times greater than the corresponding complex with TOPO. Polymer formation occurs only when nonpolar solvents are used as diluents for HDPM and is easily avoided by using polar solvents such as 1,2-dichlorobenzene. HDPM forms 1:1 and 2:1 complexes with uranium(VI) nitrate. Equilibrium constants for the complexes as well as that for the 2:1 TOPO complex were calculated and it was shown that the over-all constant is at least ten times larger for the HDPM complex than for the TOPO complex. The effect of concentration of various mineral acids, extractant concentration, temperature, and diluents on the extraction of uranium are also discussed. (auth)

35938 (ORNL-TM-634) A REVIEW OF PULSE-COLUMN FLOODING DATA AND CORRELATIONS WITH PROPOSED METHODS OF CORRELATION. R. A. McAllister and A. D. Ryon (Oak Ridge National Lab., Tenn.). June 6, 1963. Contract W-7405-eng-26. 76p.

Progress is reported in assembling available unclassified flooding data in perforated-plate pulsed extraction columns through January 1, 1963. Existing correlations are critically reviewed, and recommendations are made to develop a better flooding correlation. (auth)

35939 (UJV-873/62) TREATMENT AND RECOVERY OF THE NUCLEAR FISSION PRODUCTS. Václav Kouřím, J. Alexa, M. Bezděk, R. Caletka, V. Jeřábek, Z. Kolařík, C. Konečný, M. Kyrš, O. Vojtěch, and D. M. Wagnerová (Československá Akademie Véd. Ústav Jaderného Výzkumu, Řež). June 1963. 87p.

Work on the separation of fission products is summarized. References covering through the third quarter of 1961 are compiled. Topics covered include: composition of fission-product mixtures; composition of wastes; and methods of separating cesium, strontium, zirconium, niobium, ruthenium, rare earths, technetium, krypton, xenon, iodine, and nitric acid. Four hundred and ninety references are included. (M.C.G.)

35940 (UJV-951/63) CLASSIFICATION OF THE PROPERTIES OF PYROCLASTIC ROCKS FOR UPTAKE OF FISSION PRODUCTS. Zdeněk Dleuhý (Cheskoslovenská Akademie Věd. Ustav Jaderného Výzkumu, Řež). Aug. 2, 1963. 33p.

A large group of natural silicates, pyroclastic rocks, was classified according to their sorption properties, and according to other criteria for the selection of suitable sorbents for the decontamination of radioactive waste water. Materials, which maximally conformed to the requirements, were studied in greater detail, under static as well as under dynamic conditions. In the static experiments the distribution of the microcomponent was studied in dependence on its concentration, on pH, and on the concentration of the macrocomponent in the solution. The microcomponents studied were the radionuclides Cs and Sr, in some cases the dependences mentioned were also studied for Ce, Zr, and Nb. Freundlich's isotherm was found to be valid in the region of low concentrations for the distribution of the microcomponent. Values for pH higher than 2.5 did not influence the sorption of microamounts of all radionuclides mentioned. The sorption of Cs and Sr was more or less de-

pendent on the concentration of competing calcium and sodium ions in the solution. In a dynamic arrangement, the influences of the concentration of competing ions of the flow rate, and column length on the course of saturation curves were studied. Values found agreed well with Hiester-Vermeulen's interpretation. Data characterizing sorption columns were calculated and tabulated for the conditions employed. The best material studied, ryodacitic tuff from the locality of Nižný Hrabovec, was found to be very suitable for the sorption of radiocesium from waste water; radiostrontium sorption was also possible under certain conditions (absence of calcium ions in the solution being processed). (auth)

35941 (AEC-tr-5957) CERTAIN LAWS GOVERNING HYDRAULICS AND MASS TRANSPORT IN PACKED PULSE COLUMNS. A. M. Rozen, V. A. Vasilyev, A. I. Bezzubova, and G. P. Gorshkova. Translated for Oak Ridge National Lab., Tenn. from p.320-38 of "Ekstraktsiya, Theoriya, Primenie, Apparatura," (a publication of Gosatomizdat Moscow, 1962). 23p.

Experimental studies were carried out on the effects of pulsation, size, material, density of packing, wettability of packing, physical properties of the system, and extractor diameter on the maximum load of a packed pulse column. The column efficiency was studied using a system of aq HNO_3, uranyl nitrate, and 20% TBF. Equations were derived for the observed relationships. (D.L.C.)

35942 (AEC-tr-5958) EFFICIENCY OF PULSE COLUMNS (CONTRIBUTION TO THE GENERAL THEORY OF INTENSIFIED COUNTER CURRENT EXTRACTORS). A. M. Rozen. Translated for Oak Ridge National Lab., Tenn. from p.300-18 of "Ekstraktsiya, Theoriya, Primenie, Apparatura," (a publication of Gosatomizdat, Moscow, 1962). 33p.

In an attempt to achieve quantitative characterization of processes in intensified (pulsed) apparatus, a study was made of the effects of intensification on the elementary components of the process (breakdown of droplets, entrapment of dispersed phase, surface of phase contact, and mass transfer coefficient). The characteristics of mass transfer in actual apparatus are considered in detail. (D.L.C.)

35943 CHROMATOGRAPHIC SEPARATION OF METAL IONS BY MEANS OF PAPER TREATED WITH TRIOCTYL-PHOSPHATE. N. M. Cvjetićanin, J. D. Čvorić, and I. D. Obrenović-Paligorić. Bull. Boris Kidrich Inst. Nucl. Sci., 14: 83-93(Apr. 1963). (In English)

The chromatographic behavior of uranium, thorium, and some other metal ions and long-lived fission products was investigated on paper treated with trioctyl-phosphate. Hydrochloric, nitric, sulfuric, and perchloric acids in concentrations of 0.1-10 N were used as the elution agents. The R_f values of the ions investigated, which show the possibility of the interseparation of some cations, are given as a function of the concentration of acids. (auth)

35944 THE SEPARATION OF IODIDE, IODATE AND PERIODATE BY MEANS OF PAPER CHROMATOGRAPHY. I. D. Obrenović-Paligorić and J. D. Čvorić. Bull. Boris Kidrich Inst. Nucl. Sci., 14: 95-101(Apr. 1963). (In English)

A method for separating iodine valence states by means of paper chromatography, with the aim of controlling the radiochemical purity of I^{131}, is presented. A mixture of amyl alcohol, pyridine, and concentrated ammonium hydroxide in the proportions of 6 : 14 : 20 was used as a solvent for the separation of I^-, IO_3^-, and IO_4^-. (auth)

35945 ION EXCHANGE IN MIXED SOLVENTS. ADSORPTION BEHAVIOUR OF THE RARE EARTHS AND SOME OTHER ELEMENTS ON A STRONG-BASE ANION-EXCHANGE RESIN FROM NITRIC ACID-ALCOHOL MEDIA. METHODS FOR SEPARATION AND SPECTROPHOTOMETRIC DETERMINATION. J. Korkisch, I. Hazan, and G. Arrhenius (Universität, Vienna). Talanta, 10: 865-77(Aug. 1963). (In English)

The anion-exchange behavior of the rare earths and some other elements in aliphatic alcohols containing nitric acid is described. Based on the determination of the distribution coefficients and separation factors of the individual elements separation techniques are proposed. For the final determination of these elements the use of the azo dye Solochrome Fast Red as a spectrophotometric reagent was investigated. (auth)

35946 SEPARATION OF NIOBIUM AND TANTALUM BY CHLORINATION. S. Zahed Hussain and P. K. Jena. Trans. Indian Inst. Metals, 15: 220-6(Dec. 1962).

Niobium and Ta were separated by selective chlorination of mixed oxides by chlorine in the presence of graphite powder at 540 to 600°C. The effects of chlorine flow rate, carbon addition, chlorination temperature, and repeated chlorination with CCl_4 on Nb and Ta separation were studied. (TCO)

35947 THE EXTRACTION OF HEAVY METALS, PARTICULARLY OF URANIUM FROM LOW-GRADE ORES USING CHLORINE GAS. PART I. Walther Kangro. Z. Erzbergbau Metallhuttenw., 16: 107-12(Mar. 1963). (In German)

The thermodynamics of the formation of gaseous heavy metal chlorides and the feasibility of the extraction of the metals, particularly of uranium, in chloride form from low-grade ores was investigated. Measurement was made of the equilibria between chlorine gas, UO_2Cl_2 gas, and solid U_3O_8 or UO_2 at 1000 to 1100°C. (Rev. Metal Lit., 20: No. 8, Aug. 1963)

35948 A PILOT PLANT FOR THE PROCESSING OF URANIUM ORE AT THE BRUNHILDE PLANT AT BRIKENFELD ON THE RIVER NAHE. K. E. Wilhelms. Z. Erzbergbau Metallhuttenw., 16: 221-7(May 1963). (In German)

The design and operation of a pilot plant for dressing operations on ores containing 0.1 to 1.8% U_3O_8 and for the extraction of uranium by electronic sorting, comminution, leaching in H_2SO_4, filtering, separation by ion exchange, and precipitation of $(NH_4)_2U_2O_7$ from ammoniacal solution is described. (Rev. Metal Lit., 20: No. 8, Aug. 1963)

35949 EXTRACTION AND SEPARATION OF COLUMBIUM AND TANTALUM. R. A. Gustison and R. L. Pilloton. p.30-55 of "Columbium and Tantalum." New York, John Wiley and Sons, Inc., 1963.

The effectiveness of leaching, caustic fusion, fluoride dissolution, chlorination, and hydrofluorination as ore opening processes are discussed. Nb–Ta separation processes, including fractional crystallization of double fluorides, solid-vapor and vapor-vapor processes, distillation, and liquid-liquid extraction are reviewed. (Rev. Metal Lit., 20: No. 7, July 1963)

35950 REDUCTION METHODS. James H. Downing and Donald J. Hansen. p.57-71 of "Columbium and Tantalum." New York, John Wiley and Sons, Inc., 1963.

Methods for reducing Nb and Ta oxides, chlorides, and fluorides with metals, carbon, or hydrogen are compared. The electrolytic reduction of oxides, fluorides, and chlorides is reviewed, along with refining techniques for purifying Nb and Ta. (TCO)

35951 PROCESS OF DISSOLVING FUEL ELEMENTS OF NUCLEAR REACTORS. Eugene M. Vander Wall, David T. Bauer, and Harold T. Hahn (to U. S. Atomic Energy Commission). U. S. Patent 3,102,849. Sept. 3, 1963.

A process is described for dissolving stainless-steel- or zirconium-clad uranium dioxide fuel elements by immersing the elements in molten lead chloride, adding copper, cuprous chloride, or cupric chloride as a catalyst and passing chlorine through the salt mixture. (AEC)

ENGINEERING AND EQUIPMENT

General and Miscellaneous

Refer also to abstracts 36425, 36465, and 36860.

35952 (BNL-6489) A SUBLIMATION PUMP. C. L. Gould and P. Mandel (Brookhaven National Lab., Upton, N. Y.). Sept. 20, 1962. Contract [AT(30-2)-Gen-16]. 12p.

The modification of the wire evaporation type getter-ion vacuum pumps of the alternating-gradient synchrotron from the evaporation technique to a W sublimation principle is outlined. The sublimation pumps have given pressures of 2×10^{-7} torr and offer very long periods of maintenance-free service. Use of several W rods with sufficient voltage seems to offer pumping rates of thousands of liters/sec. (D.C.W.)

35953 (CLM-R-23) A MASS SPECTROMETRIC STUDY OF THE OUTGASSING OF SOME ELASTOMERS AND PLASTICS. PART 2. R. S. Barton and R. P. Govier (United Kingdom Atomic Energy Authority. Research Group. Culham Lab., Culham, Abingdon, Berks, England). Apr. 1963. 40p.

Mass spectra resulting from the presence of various plastic materials and elastomers in a vacuum system are shown and interpreted and the method by which they were obtained is explained. (auth)

35954 (DASA-1285(Pt.V)) NUCLEAR GEOPLOSICS. A SOURCEBOOK OF UNDERGROUND PHENOMENA AND EFFECTS OF NUCLEAR EXPLOSIONS. PART V. EFFECTS ON UNDERGROUND STRUCTURES AND EQUIPMENT. N. M. Newmark and J. L. Merritt (Illinois. Univ., Urbana). July 15, 1962. Contracts DA-49-146-XZ-027 and DA-49-146-XZ-030. 159p. (AD-291537)

The effects of nuclear explosions on underground structures and equipment located in buried structures are presented. Emphasis of the discussion is on the character of the stress wave and the associated forces which act on structures buried below the surface. A summary and discussion are presented of the theoretical results and empirical data which form the basis for current design procedures. (auth)

35955 (HW-75299) TESTING FILTER CONDITIONS. R. W. Pitman (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Oct. 17, 1962. Contract AT(45-1)-1350. 7p.

An apparatus is described for determining the effectiveness of the coagulant aid that is to be used as a filter conditioner in the alum-filter conditioner treatment of raw water from the water treatment plant. The operation of the apparatus is described, and notes on turbidity measurements and operation are given. (D.L.C.)

35956 (LADC-5761) AUTOMATED FUEL ELEMENT GAMMA COUNTING AND WEIGHING FOR HIGH PRODUCTION POST-MORTEM ANALYSIS. Mahlon T. Wilson and Linas L. Thorn (Los Alamos Scientific Lab., N. Mex.). [nd]. Contract [W-7405-eng-36]. 17p. (CONF-187-3)

For Presentation at American Nuclear Society Meeting, New York, Nov. 1963.

Equipment was developed for the rapid handling of irradiated fuel elements for post-mortem analysis. Element weights and total gamma energy outputs are obtained, and this data is presented visually and on punched tape for computer correction and plotting. The electrically and pneumatically powered equipment is operated by a crew of three men. The output of the equipment averages one element every 65 seconds and to date over 1900 elements have been processed. The balance is capable of giving weights to an accuracy of one part in five thousand. (auth)

35957 (LADC-5772) LOS ALAMOS RADIOCHEMISTRY HOT CELLS. Philip F. Moore and John D. Allen (Los Alamos Scientific Lab., N. Mex.). [nd]. Contract [W-7405-eng-36]. 7p. (CONF-187-4)

For Presentation at American Nuclear Society Meeting, New York, Nov. 1963.

The major expansion of the hot cell facilities at the Los Alamos Radiochemistry Building from three to sixteen cells is described. The cell design, building layout, materials handling operations, special systems and equipment, and construction costs are discussed. (D.L.C.)

35958 (NAA-SR-Memo-7470) STRUCTURAL ANALYSIS OF A SQUARE BOX UNDER INTERNAL PRESSURE. P. L. Goodman (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). June 8, 1962. Contract [AT(11-1)-Gen-8]. 22p.

The results of the analysis indicate that the maximum stress in the box will occur on the inner radius of the box corner, and will be due primarily to the bending moments at the juncture between wall and corner. The outward deflection of the box walls, and thus the box expansion, is primarily due to the bending of the walls alone. A sample calculation was made for a 3 in. square APM box with 15 psi internal pressure and 0.120 in. inner radii at the corners. Using an allowable creep rate of 1% in 10,000 hr as the design criterion, the resulting box will have a wall 0.096 in. thick and will expand a total of 0.050 in. (auth)

35959 (NYO-9800) HIGH PRESSURE PUMP SEAL DEVELOPMENT. Engineering Quarterly Progress Report September–November 1962. Robert C. Hajner (Worthington Corp. Advanced Products Div., Newark, N. J.). Dec. 10, 1962. Contract AT(30-1)-2682. 69p.

The full size seal ($5\frac{1}{2}$" shaft diameter) was redesigned to incorporate the latest seal geometry which was developed as a result of the model seal test program. A number of compatible seal face material combinations, which performed satisfactorily during the model seal test program, was also selected for evaluation in the full size seal. All the detail drawings of the seal and test stand were completed. A test program for the full size seal was prepared and approved. (auth)

35960 (NYO-10150) STRESSES AT NOZZLE CONNECTIONS OF PRESSURE VESSELS. Quarterly [Progress] Report, October 1, 1962–December 31, 1962. Donald E. Hardenberg and Sam Y. Zamrik (Pennsylvania State Univ., University Park). Jan. 18, 1963. Contract AT(30-1)-1874. 20p.

Stress measurements at rosettes around and in the nozzle outlet R of a test vessel are tabulated. Strain rosettes were placed on the exterior and interior surfaces of the nozzle outlet S of the test vessel for strain measurements. (D.L.C.)

35961 (ORNL-TM-648) WASTE PROCESSING PUMP TEST LOOP PROGRESS REPORT, JULY 1, 1963. C. W. Hancher and E. J. Frederick (Oak Ridge National Lab., Tenn.). Aug. 7, 1963. Contract [W-7405-eng-26]. 14p.

A life operation test of four canned-rotor type pumps

was initiated to determine the feasibility of their use as waste evaporator circulation pumps for the Hanford Waste Calcination Prototype. A description is given of the installation, startup, and the first 300 hours of operation of the pump test loop. Three of the pumps have given satisfactory performance. Testing of the fourth pump was terminated after 47 hours because of its low discharge pressure relative to the other pumps undergoing tests. (auth)

35962 (PNE-108F) PARTICLE MOTION NEAR A NUCLEAR DETONATION IN HALITE. W. D. Weart (Sandia Corp., Albuquerque, N. Mex.). Feb. 1963. Projects 44.1 and 1.1 [of] PROJECT GNOME. Contract AT(29-1)-789. 80p.

Strong motion parameters from the Project Gnome operation were measured in the region extending 60 to 480 meters from the center of detonation or working point along both vertical and horizontal radii. Travel-time data from the horizontal radius reveals three distinct arrivals. First arrivals are propagated through a polyhalite layer with a velocity of 4.839 km/sec and are followed by the direct elastic wave arrival in the salt horizon (4.318 km/sec) and the plastic wave, which decreases in velocity as the stress level diminishes. Vertically, the velocity varies from 5.1 km/sec at about 60 meters above the shot to 0.785 km/sec a few meters below the surface. Peak accelerations in the salt are best fitted by the relations $A = 890\ R^{-5.3}$ from 60 to 122 meters and $A = 560\ R^{-2.7}$ from 122 to 480 meters, where R is in hundreds of meters and A is in units of gravity. Peak particle velocity in the salt is given by $U = 13\ R^{-3.56}$ from 60 to 100 meters and $U = 13\ R^{-1.36}$ from 100 to 480 meters. Motion of the ground above the shot reveals that spalling occurred at several horizons. The deepest spall separation was below 92 meters. These effects were most pronounced at the surface where the initial acceleration, velocity, and displacement peak values were A = 25 g, U = 5.6 m/s, and D = 168 cm. Residual upward displacement at surface zero at +5 minutes was 79 cm. (auth)

35963 (TID-19364) SODIUM RESISTIVITY METER LOOP. Summary Report, July 1963. (Atomic Power Development Associates, Inc., Detroit). Contract AT(11-1)-865. 6p.

An experiment was conducted in which sodium hydride was introduced into the flowing Na loop by "tea bag," and the resistivity meter was calibrated against the rising level of contamination. The resistivity meter responded satisfactorily. A variable-orifice plugging meter was also tested and found to operate satisfactorily, while a nickel diffusion-tube hydrogen detector did not respond to loop contamination. Sodium samples were taken from the loop for analysis. The difficulties (additional contamination, etc.) encountered in clean-up of the loop are described. (D.L.C.)

35964 (UCRL-7191) A LOW INTERRUPTING CAPACITY FUSE FOR ENERGY-STORAGE CAPACITOR BANKS. Robert J. Thomas (California. Univ., Livermore. Lawrence Radiation Lab.). May 8, 1963. Contract W-7405-eng-48. 37p. (CONF-24-17)

From 4th Symposium on Engineering Aspects of Magnetohydrodynamics, Berkeley, Calif., Apr. 1963.

An indicating fuse with a relatively low interrupting capacity developed for fault protection of energy-storage capacitor banks is described. It is intended for location in a separate charging circuit, thereby obviating the more difficult interruption and coordination requirements of fuses located in the energy discharge circuit. Characteristics, designing, and performance of the fuse (a spring-loaded carbon resistor fuse element enclosed in an arc expulsion tube) are considered. (auth)

35965 (UCRL-7401) TEST RESULTS FOR A $7\frac{1}{8}$-INCH I.D × 12-INCH-LONG SODIUM CRYOGENIC COIL. C. E. Taylor and R. L. Nelson (California. Univ., Livermore. Lawrence Radiation Lab.). June 19, 1963. Contract W-7405-eng-48. 14p.

A $7\frac{1}{8}$-inch inside diameter × 12-inch-long sodium cryogenic coil, having 77 turns of 0.605-inch-square conductor, was designed, fabricated, and tested to 21-kguass central field. A sodium still was developed to produce the high purities required in the conductor. A refrigerator capable of testing this coil was designed and constructed. Test results show a total coil resistance of about 4×10^{-6} ohms at 21 kgauss with a current of about 10,000 amperes. This observed resistance is lower than the resistance expected, based on small sample measurements, by a factor of about 2. The test was prematurely terminated by a mechanical failure before the design field was reached. This failure was apparently caused by cracking of a brittle weld in the conductor encapsulation tube, which in turn was probably caused by differential thermal contraction of the coil when repeatedly cooled from room temperature to about 11°K. The failure was not associated with inadequate cooling of the conductor under operating conditions. (auth)

35966 HIGH RADIATION LEVEL CELLS AND EQUIPMENT (Engineering Materials). (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). (CAPE-1019)

This package contains 123 drawings. Remote control equipment and layouts used in the High Radiation Level Cells at the Savannah River Laboratory are described. The equipment includes that used in the Power Components Examination Facility (PCEF), Metallography Examination Facility (MEF), Metallography Preparation Facility (MPF), and Cutting and Examination Facility. The equipment used in cell 1 includes a Tinius Olsen tester and a bulk density balance. Cell 2 contains a boroscope and a monocular periscope. A cutting machine and a furnace are located in cell 3; and a hoist is located in cell 4. Cells 5 and 9 are used for metallography. Etchers, polishers, and a periscope are used in cell 6, and an ultrasonic cleaner is used in cell 7. (F.L.S.)

35967 PLUTONIUM RESEARCH GLOVEBOXES (Engineering Materials). (Argonne National Lab., Ill.). (CAPE-1024)

This package contains 141 drawings. Gloveboxes used for plutonium research in the Fuels Technology Center in metallurgy research are described. The boxes are constructed of aluminum extrusions, are modular in design, and are flexible for application with many types of research equipment. The boxes, if properly assembled, are suitable for use with high-purity inert-gas atmospheres. There are 8 standard sizes. These are designated by the letters "S" for single and "D" for double which indicate the depth, length, and height respectively. There are 8 different combinations of modules, e.g., DDS, SSS, DSD, etc. The aluminum extruded frame normally accommodates $\frac{3}{8}$ in. thick safety glass panels and either $\frac{1}{2}$ or 1 in. thick aluminum panels. A variety of hardware was designed which permits the transfer of material or installation of utilities while maintaining the integrity of the sealed enclosure. (F.L.S.)

35968 PLASTIC BAG AND SEALING DEVICE (Engineering Materials). (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). (CAPE-874)

This package contains 4 drawings and 2 photographs. The plastic bag and sealing device is an application of flexible plastics for contamination control. It utilizes a small bag made of flexible polyvinyl chloride and is sealed on all sides except one end. This open end is attached to an elastic cord which permits it to be stretched over a protruding ring on the side of the process enclosure. Since it is made of polyvinyl chloride, it is possible to seal the bag electronically using a jaw-type sealing bar. Materials inserted into the end of the bag can thus be separated from the remaining portion of the bag by tear sealing. This permits removal of materials through access parts of process enclosures without creating any opening in the contaminated barrier. Since this method successfully confines all radioactive materials, it precludes the need for protecting the entire area of the room. (F.S.)

35969 POWER ADAPTER SYSTEMS FOR ELECTROTHERMAL ENGINES. William A. Geideman, Jr. (Plasmadyne Corp., Santa Ana, Calif.). New York, American Institute of Aeronautics and Astronautics, 1963, Preprint 63025-63, 8p. (CONF-10-46)

From Electric Propulsion Conference, Colorado Springs, Colo., Mar. 1963.

The electrical outputs of all the proposed space power plants are summarized. The electrical power requirements of electrothermal arc-jets (both a-c and d-c) and resistojets are listed. The power adapter system requirements for each combination of space power plant and electrothermal engine are described and analyzed. These systems are compared on the basis of overall electrical efficiency and system weight. The possibilities of power plant changes to optimize the power system are discussed. The various components of the power adapter system, namely, the transformers, stabilization devices, and rectifiers are discussed in detail with respect to their effect on the overall weight, efficiency, and reliability of the system. Several different stabilization techniques are discussed. The rectification system is discussed in detail with respect to the effects of various factors associated with the engine and environment on the efficiency and reliability of the system. Different methods of rectification are compared on the basis of weight, reliability, and efficiency. The power factor of the system is compared for each of the proposed combinations. Methods of power factor correction are also discussed. For the case of a-c arc-jet engines operated from an a-c power source, the effects of generator output frequency on the engine operating characteristics are discussed in their relation to the power system. The effect of frequency on the weight of system components is also discussed. (auth)

35970 HIGH VACUUM PUMPING SYSTEMS. (to Varian Associates). British Patent 932,012. July 24, 1963. Priority date Mar. 30, 1959, United States.

A method and apparatus for creating an extremely high vacuum in a structure by means of an electrical vacuum pump and an appendage pump are patented. The structure and electrical pump are first evacuated by cooling the appendage pump, which contains highly sorbent material such as charcoal. The appendage pump is then sealed off from the structure, and final evacuation is performed by the electrical pump. Before cooling the appendage pump, the structure is flushed with a gas having a condensation temperature above that to which the appendage pump will be cooled. The efficiency of the charcoal can be improved by first freezing out water and CO_2 in a separate chamber of the appendage. The appendage pump should be cooled at least to the temperature of liquid N. (M.P.G.)

35971 IMPROVEMENTS IN AND RELATING TO VACUUM PUMPS. (to Varian Associates). British Patent 932,013. July 24, 1963. Priority date Mar. 30, 1959, United States.

A vacuum pump for use in a system to obtain extremely low pressure is patented. The pump consists of a chamber containing highly sorbent material in direct contact with heat-conducting walls. The area of the conducting walls in contact with the sorbent material must be greater than 5 times the largest projected area of the chamber. The chamber may also contain an inner wall coated with sorbent material. The chamber is connected to the structure to be evacuated and immersed in a refrigerating liquid such as liquid N. When the pressure has been reduced to between 10^{-1} and 10^{-3} mm Hg, the chamber is sealed off, and the structure is further evacuated by an electrical vacuum pump. (M.P.G.)

35972 HIGH VACUUM PUMPING SYSTEMS. (to Varian Associates). British Patent 932,014. July 24, 1963. Priority date Mar. 30, 1959, United States.

The design of a vacuum-pump system for producing valua on the order of 1×10^{-9} mm Hg is patented. A vacuum-tight chamber containing highly sorbent material, such as activated charcoal, is connected to the structure to be evacuated and to the vacuum pump. The chamber is immersed in a refrigerating liquid and absorbs gas within the structure and the pump until the pressure has been reduced to between 10^{-1} and 10^{-3} mm Hg. The chamber is then separated from the rest of the system by closing a valve, and the pump reduces the pressure to the desired value. For more surface area of sorbent material, a cylindrical shell can be inserted in the chamber. The sorbent material is held against the inner and outer walls of the shell and against the walls of the chamber by a mesh grid or other gas-pervious material. (M.P.G.)

35973 IMPROVEMENTS IN OR RELATING TO SAMPLE CONVEYORS FOR RADIO ACTIVITY INVESTIGATIONS. (to N. V. Philips' Gloeilampenfabrieken). British Patent 932,110. July 24, 1963. Priority date Aug. 29, 1958, Germany.

A radioactive-sample conveyor, in which samples are transferred successively to a radiation meter and remain there for a predetermined period, is patented. The conveyor consists of a driven endless chain carrying a plurality of sample cups. A forked member transfers the cups in succession from the chain to a shielded chamber containing the radiation meter and returns the cups to the chain after the predetermined period. Additional features of the conveyor are described. (M.P.G.)

35974 VACUUM CONTROL VALVE. Gilles Aubert, Maxime Givelet, and Albert Recule (to Commissariat à l'Énergie Atomique). British Patent 932,194. July 24, 1963. Priority date May 27, 1960, France.

A fully openable vacuum control valve, which is particularly applicable to large diameter passages, is patented. The valve consists of a flap, held in its closed position, on a metal seat, which can be sealed against a high vacuum. The flap is swung into its open position by the displacement of 2 control rods, which pass through the wall of the valve in an airtight manner by means of metal bellows. The flap's open position is substantially perpendicular to its closed position. (M.P.G.)

35975 IMPROVEMENTS IN OR RELATING TO DEVICES FOR TREATING FLUIDS. Pierre Dequenes (to Commissariat à l'Énergie Atomique). British Patent 932,499. July 31, 1963. Priority date Mar. 1, 1960, France.

A device for treating fluids, especially radioactive ones, is patented. The device consists of an external bowl with fluid inlet and outlet apertures and a removable inner enclosure containing the means for treating the fluid. A sliding shutter blocks the opening into the inner enclosure when the enclosure is being removed. The enclosure gives radiological protection and can be used for filtering fluids under pressure. Elements for treating the fluids can be easily changed with radiological protection without dismantling the outer pressure-resistant bowl, to which the inlet and outlet pipes are welded. (M.P.G.)

35976 IMPROVEMENTS IN OR RELATING TO PIPE-WORK INSTALLATION. Samuel Brittan Hosegood, Frank Taylor, Eric Barnes, and Cecil Harper (to United Kingdom Atomic Energy Authority). British Patent 932,651. July 31, 1963. Filed Sept. 7, 1960.

A method of remotely cutting and welding pipes in pipework installations is patented. The component, which must be replaced by remotely operable means, is connected to the permanent installation by a T-pipe with vertically aligned limbs. The stem of the T is connected to the replaceable component, and an internal weld in a horizontal plane connects the downwardly extending limb to the vertical permanently installed pipe. The upper end of the upper limb is closed by a removable closure cap and serves as a blind access conduit for making or cutting the internal weld by remotely operable tools. This makes it possible for the remote cutting or welding tool to operate in one plane only. (M.P.G.)

35977 IMPROVEMENTS IN OR RELATING TO BALL LOCK CLAMPING DEVICES. Viggo Henning Srensen (to United Kingdom Atomic Energy Authority). British Patent 932,795. July 31, 1963. Filed July 19, 1960.

A locking device for securing together interfitting coaxial tubular members is patented. The device will not impair the efficiency of any intermediate sealing device and can be actuated without applying a large torque. A ring of balls is mounted between the tubular members. One member has a ball-contacting nut, and the other member has a locking recess with a part-conical surface, which is engageable by the balls during rolling to draw the members together and then lock them together as the balls enter the recess. The locking device can be used with a remotely operable closure mechanism for clamping cylindrical containers for fuel elements. (M.P.G.)

35978 IMPROVEMENTS IN OR RELATING TO FLUID FLOW SELECTOR VALVES. Rene Donguy, Andre Roguin, and Jean Megy (to Commissariat à l'Energie Atomique). British Patent 932,912. July 31, 1963. Priority date June 4, 1959, France.

A rotary selector valve is patented, which can control the communication of a plurality of conduits with an outlet opening into a chamber of a stationary valve casing. The selector valve can be used in installations for the detection of fuel-element-casing failure or whenever variable communications between a certain number of inlet passageways traversed by a fluid and one or more outlet passageways are desired. (M.P.G.)

35979 DIFFUSION PUMP. Leonard Levenson (to U. S. Atomic Energy Commission). U. S. Patent 3,102,678. Sept. 3, 1963.

A high-vacuum diffusion pump is described, featuring a novel housing geometry for enhancing pumping speed. An upright, cylindrical lower housing portion is surmounted by a concentric, upright, cylindrical upper housing portion of substantially larger diameter; an uppermost nozzle, disposed concentrically within the upper portion, is adapted to eject downwardly a conical sheet of liquid outwardly to impinge upon the uppermost extremity of the interior wall of the lower portion. Preferably this nozzle is mounted upon a pedestal rising coaxially from within the lower portion and projecting up into said upper portion. (AEC)

35980 A POSITIONAL DATA SYSTEM. George A. Forster (to U. S. Atomic Energy Commission). U. S. Patent 3,105,189. Sept. 24, 1963.

An apparatus for obtaining a positional error signal between master and slave synchros is described. A three-phase a-c power source is connected to the stators of the synchros and an error detector is connected to the rotors of the synchros to measure the phasor difference therebetween. A phase shift network shifts the phase of one of the rotors 90 degrees and a demodulator responsive thereto causes the phasor difference signal of the rotors to shift phase 180 degrees whenever the 90 degree phase shifted signal goes negative. The phase shifted difference signal has a waveform which, with the addition of small values of resistance and capacitance, gives a substantially pure d-c output whose amplitude and polarity is proportional to the magnitude and direction of the difference in the angular positions of the synchro's rotors. (AEC)

Heat Transfer and Fluid Flow

Refer also to abstract 36879.

35981 (AEEW-R-255) PRELIMINARY RESULTS OF STATISTICAL DYNAMIC EXPERIMENTS ON A HEAT EXCHANGER. E. R. Corran and J. D. Cummins (United Kingdom Atomic Energy Authority. Reactor Group. Atomic Energy Establishment, Winfrith, Dorset, England). Oct. 1962. 80p.

The inherent noise signals present in a heat exchanger were recorded and analyzed in order to determine some of the statistical dynamic characteristics of the heat exchanger. Preliminary results show that the primary-side temperature frequency response may be determined by analyzing the inherent noise. The secondary-side temperature frequency response and cross-coupled-temperature frequency responses between primary and secondary were poorly determined because of the presence of a non-stationary noise source in the secondary circuit of the heat exchanger. This may be overcome by correlating the dependent variables with an externally applied noise signal. Some preliminary experiments with an externally applied random telegraph type of signal are reported. (auth)

35982 (AEEW-R-284) TWO-PHASE PRESSURE DROP — COMPARISON OF THE "MOMENTUM EXCHANGE MODEL" AND MARTINELLI AND NELSON'S CORRELATION WITH EXPERIMENTAL MEASUREMENTS. M. Muscettola (United Kingdom Atomic Energy Authority. Reactor Group. Atomic Energy Establishment, Winfrith, Dorset, England). May 1963. 62p.

This paper compares some two-phase flow experimental results on friction pressure gradient with theoretical models suggested by Levy and by Marchaterre and with the Martinelli and Nelson correlation. (auth)

35983 (ANL-6715) HEAT TRANSFER, FLOW INSTABILITY, AND CRITICAL HEAT FLUX FOR WATER IN A SMALL TUBE AT 200 psia. R. J. Weatherhead (Argonne National Lab., Ill.). June 1963. Contract W-31-109-eng-38. 28p.

Heat transfer data from a vertical Type-304 stainless

steel tube (0.045 in. in ID; 4.5 in. long) operating at 200 psia in forced-convection heating and subcooled nucleate boiling was compared with and agreed with the equations $h = [(G)^{0.8}/10^3(D)^{0.2}] (T_B)^{0.5}$ Btu/(hr)(ft²)(°F); and $T_w - T_{sat} = 0.18 \times 10^6 \sigma(Q''/10^6)^{0.25}$ °F. Critical heat-flux data from the same system in the subcooled froth-flow regime was compared with and agreed with the correlation $Q_c''/10^6 = 1.75(H_{fg}/10^3) (D_e)^{-0.5} [1 + (G/10^6)]^{0.5} (H_f - H/100)$ Btu/(hr)(ft²). The effects of developing two-phase flow regimes in a constant-pressure drop system are shown in recorded traces from a fast-response flow transducer: the mass velocity decreased and transfer-surface superheat increased with increasing steam quality. Examples of the hypothesized two-phase regimes of froth flow, slug flow, and stable and unstable annular flow are presented, and the critical heat flux occurrence is shown to have a hydrodynamic cause and distinctly characteristic trend in the unstable flow regimes. (auth)

35984 (ANL-6754) AN EXPERIMENTAL INVESTIGATION OF TWO-PHASE, TWO-COMPONENT FLOW IN A HORIZONTAL, CONVERGING-DIVERGING NOZZLE. Joseph A. Vogrin, Jr. (Argonne National Lab., Ill. and Associated Midwest Universities, Lemont, Ill.). July 1963. Contract W-31-109-eng-38. 134p.

Thesis submitted to Illinois Inst. of Tech., Chicago.

A discussion is presented of an investigation of the flow characteristics in a horizontal, converging-diverging nozzle for a two-phase, air–water system. The primary consideration, to determine the effects of accelerating the liquid phase by the gaseous phase, was measured in terms of nozzle exit water velocity, exit slip ratio, and exit acceleration factor. A gamma-ray-attenuation technique was used to determine these values by determining the average cross-sectional void fraction, the ratio of gas volume to total volume, for the air–water mixture. (B.O.G.)

35985 (DPST-63-69-8) EFFECT OF ROD SPACING ON HEAT TRANSFER BURNOUT. USAEC-AECL Cooperative Program Monthly Progress Report, July 1963. R. H. Towell (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). Aug. 1963. Contract AT(07-2)-1. 6p.

The purpose of the study is to determine the effect of closely spaced fuel rods and high effluent qualities on the heat transfer and hydraulic characteristics of rod bundles. The effects of spacers and both vertical and horizontal oreintation will also be determined. All components of the Star Test Section with the exception of the surrounding-rod mockup have been fabricated. The program has been delayed since about May 1, 1963 because the surrounding-rod mockup, which was contracted to a vendor, has not been fabricated. A Du Pont inspector visited the vendor's plant and found that it is unlikely that the vendor will deliver the finished mockups. The SRL shop is grinding the tools required to fabricate a surrounding-rod mockup that is expected to be finished by September 13, 1963. A loading test of the central-rod mockup was made with an annular housing tube installed in the pressure shell. The test showed that several minor modifications would have to be made in the loading procedure and equipment in order to keep the central-rod mockup aligned and to prevent breaking of the sapphire spacer pins. (auth)

35986 (HW-77681) TEMPERATURE DISTRIBUTION IN LONG CYLINDRICAL FUEL ELEMENTS COOLED INTERNALLY BY SEVERAL CHANNELS. D. E. Amos and F. R. Zaloudek (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). May 1963. Contract AT(45-1)-1350. 29p.

Analysis is made of the temperature distribution in cylindrical fuel elements cooled internally by longitudinal cooling channels. The heat conduction equation is solved using the concept of sources and sinks for two fuel configurations: one with cooling channels located symmetrically on a common circle and the other with an additional axial channel. (D.L.C.)

35987 (LAMS-2934) TEMPERATURE-FLOW STABILITY EXPERIMENTS. F. A. Guevara, B. B. McInteer, and R. M. Potter (Los Alamos Scientific Lab., N. Mex.). July 10, 1963. Contract W-7405-eng-36. 52p.

The results of this experimental investigation give conclusive evidence that temperature-flow instability occurs in a system which has helium flowing through a uniformly heated channel if there is an increase in the gas temperature by a factor of 3.6 or more. This instability occurs for values of ΔP and Q corresponding to the region of negative slope on a steady state pressure drop versus flow diagram. When a plenum precedes the channel the instability appears as sustained oscillations if an attempt is made to operate the system in the unstable region. The recorded observations of this behavior are discussed in detail. The final observation reported is that temperature-flow instability can be overcome by the addition of an introductory impedance to the system. (auth)

35988 (NAA-SR-7909) BOILING STUDIES FOR SODIUM REACTOR SAFETY. PART I. EXPERIMENTAL APPARATUS AND RESULTS OF INITIAL TESTS AND ANALYSIS. R. C. Noyes (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Aug. 30, 1963. Contract AT(11-1)-Gen-8. 74p.

An experimental and analytical research program is described that is designed to meet certain specific needs for data and methods required to make improved predictions of transient voids, burnout, flow, and fuel temperature during extreme accidents in sodium-cooled reactors. Part I includes design, fabrication, and installation of experimental apparatus and preliminary experiments and theoretical analysis. Two sodium loops are described that are capable of operating in the boiling range. Special high-pressure electromagnetic induction pumps are described that produce pressures up to 200 psi at 6 gpm. Discussion covers details of fabrication and testing of a new type of instrumented electric heating element capable of accurate surface temperature measurement at heat fluxes to 1,000,000 Btu/hr-ft² in boiling sodium. Boiling heat transfer coefficients measured for sodium at 1.0, 1.7, 3.0, and 8.0 psia at heat fluxes to 10^6 Btu/hr-ft² were found to range between 35,000 and 250,000 Btu/hr-ft²-°F. Measurements of burnout heat flux for sodium pool boiling at pressures between 1.0 and 8.0 psia were between 400,000 and 1,000,000 Btu/hr-ft² and increased approximately as the square root of pressure. Burnout measurements are correlated nondimensionally with data for other materials, and this correlation has been used to find an extrapolated value of 2,100,000 Btu/hr-ft² for sodium at 1 atm. The pool boiling data are used together with theoretical analysis to predict subcooled burnout for sodium and to calculate typical values of 10 or greater for the burnout margin in sodium-cooled reactors. A digital method for transient analysis of two-phase flow is outlined. (auth)

35989 (TID-17854) SOME IDEAS ABOUT THE MECHANISM CAUSING TWO-PHASE CRITICAL FLOW. Hans K. Fauske (Argonne National Lab., Ill.). Nov. 1962. Contract W-31-109-eng-38. 22p. (UAC-7043)

While the theory concerning critical discharges of single-phase flow, in particular of gases, is well known, the direct

opposite is true for two-phase mixtures. The question still remains to be answered whether critical flow occurs for two-phase flow with the same implications that it carries for single-phase flow. A theoretical analysis, which is supported by experimental data, is presented and indicates that the implications for single-phase and two-phase critical flow differ significantly. While single-phase flow is restricted by so-called sonic choking, the extra freedom available in a two-phase flow system, the slip ratio, restricts the maximum flow in the latter. Furthermore, two-phase critical flow is achieved when the slip ratio takes on a value such that the rate of momentum gain by convection per unit volume becomes identical in each fluid phase. (auth)

35990 (TID-19326) STEAM-WATER FLOWS THROUGH APERTURES. Bimonthly Report. H. S. Isbin and P. C. Chen (Minnesota. Univ., Minneapolis). Aug. 15, 1963. Contract AT(11-1)-926. 14p.

The design and evaluation of a system for measuring two-phase flow through different orifices are presented. Originally, it was believed that flashing would occur within the pressure vessel. Tests with the sharp-edged opening with a 12° taper indicate that the flashing occurs within the tapered section. (N.W.R.)

35991 (WAPD-TM-302) XITE—A DIGITAL PROGRAM FOR THE ANALYSIS OF TWO-DIMENSIONAL BOILING FLOW TRANSIENTS WITH FLUID EXPANSION. R. P. Rose and R. S. Pyle (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Apr. 1963. Contract AT(11-1)-Gen-14. 46p.

The XITE program for analysis of steady-state and transient behavior in a single reactor coolant channel is described. The XITE program, like its predecessor TITE, represents a vertical rectangular channel with two-dimensional flow and a nonuniform axial and transverse heat flux distribution at the walls. Unlike the TITE program, XITE includes the time derivative of fluid density in the continuity equation such that more rapid transients (e.g., flow oscillations) can be analyzed. The XITE model treats two-dimensional convection of mass, momentum, and energy in the coolant for subcooled, nucleate and bulk boiling conditions. Time variations in power, inlet enthalpy, and either inlet mass velocity or channel pressure drop may be imposed as transient driving functions. The XITE program was assembled by the ALTAC system for a 32,000 word Philco 2000 computer. (auth)

35992 (AERE-Trans-946) THE CONNECTION BETWEEN THE LAMINAR FLOW OF PURE GASES THROUGH TUBES AND THE SELF-DIFFUSION COEFFICIENT. S. Weber. Translated by R. Ash and J. B. Sykes (U.K.A.E.A. Atomic Energy Research Establishment, Harwell, Berks, Eng.) from Kgl. Danske Videnskab. Selskab, Mat. Fys. Medd., 28: No. 2, 1-138(1954). 99p.

A survey is made of the research results of Knudsen and others on the molecular and laminar flow of gases through tubes. Some recalculations were made on Knudsen's observations, and a theoretical investigation was carried out on the variation of the gas flow terms with R/λ (R = tube radius and λ = mean free path). Methods for calculating the slip coefficient are considered. The exact theory of pure molecular flow is treated. The theoretical results and equations are compared with Knudsen's work on CO_2. The agreement is found to be very good, and it is concluded that the total gas flow is composed of three independent flows in the range $0 \leq R/\lambda \leq \infty$: self-diffusion or pressure diffusion flow, gas-kinetic slip flow, and hydrodynamic laminar Poiseuille flow. It is pointed out that the self-diffusion coefficient of a pure gas is a measurable physical quantity. (D.L.C.)

35993 (TRG-Inf-Ser-306) HEAT TRANSFER IN NUCLEATE BOILING OF A LIQUID. D. A. Labuntsov. Translated by A. G. Hamlin (U.K.A.E.A. Reactor Group, Risley, Lancs, Eng.) from Teploenerg., [6]: No. 12, 19-26 (1959). 15p.

Conditions for the formation of vapor during boiling of a liquid are discussed. Equations are presented to show that the greatest probability of generating vapor is in cavities in the heating surface. The conditions for formation of nuclei of vapor on the surface of the heater in the case of a wetting liquid are shown to be qualitatively similar to the conditions for the formation of nuclei in the body of the liquid in the sense that the production of nuclei has a statistical nature and is really possible only in the presence of specific superheating of the liquid. The rate of growth of a vapor bubble at the moment following its generation is defined by the intensity of the heat transfer from the surrounding superheated liquid. Reasons for the high intensity of heat exchange in nucleate boiling of liquids which wet the heating surface were identified. Systems of similarity criteria were derived for heat transfer in nucleate boiling and for critical thermal loading under conditions of free movement of the boiling liquid. (M.C.G.)

35994 INVARIANT IMBEDDING AND RAREFIED GAS DYNAMICS. J. Aroesty, R. Bellman, R. Kalaba, and S. Ueno (RAND Corp., Santa Monica, Calif.). Proc. Natl. Acad. Sci. U. S., 50: 222-6(Aug. 15, 1963).

Invariance principles and invariant imbedding techniques are applied to representative problems in the kinetic theory of gases. The problem of plane shear flow between two infinite flat plates is used to present the ideas of invariant imbedding in the context of rarefied gas dynamics. (C.E.S.)

35995 AN EXPERIMENTAL STUDY OF SATURATED BOILING. NOTE I. THE EFFECT OF SURFACE TREATMENTS ON THE SPECIFIC HEAT FLUX. Sergio Faggiani (Università, Rome). Ric. Sci., Rend., 3: 591-8(July 1963). (In Italian)

Some experimental results of heat transfer to boiling water on Pt and Ni wires under atmospheric pressure are reported. The possibility of increasing the specific thermal flux by particular surface treatment is demonstrated, which allows values of Φ_{max} ranging in the order of 1.72×10^6 kcal/h m^2 (200 watt/cm^2) in saturated nucleate boiling to be obtained. (auth)

35996 A NEW APPROACH ON ENGINEERING HOT CHANNEL AND HOT SPOT STATISTICAL ANALYSIS. U. L. Businaro and G. P. Pozzi (FIAT, Sezione Energia Nucleare, Turin). 77p. (CONF-39-91)

From American Nuclear Society 9th Annual Meeting, Salt Lake City, June 1963.

A nuclear core is physically defined by a certain number of independent variables (x_i), which define core geometry and material characteristics: for example, fuel density and enrichment, fuel radius, and cladding internal and external radius. These x_i variables are subjected to statistical variations from point to point in the core. On designing a reactor, one is faced with the problem of determining certain thermal and hydraulic dependent variables $Y = f(x_1, \ldots, x_i, \ldots)$. To solve the problem of how the statistical nature of the x_i's influence the Y values, account is taken of the fact that the thermal and hydraulic variables Y's depend: on local values of the x_i's; and on

neutron-flux spatial distribution and on the entire reactor thermal and hydraulic conditions. To do this a geometrical core model is built up. This model, called a "spot model", considers each fuel channel as divided in small regions: in each of these small regions the x_i's may be assumed constant and their actual values are chosen at random (independently one from the other, and in an independent way from region to region) according to their experimental distribution curves resulting from fabrication tolerances. Having represented in this way an "actual" core, it is possible, with the aid of a detailed thermal and hydraulic calculation routine, to evaluate the Y variables relative to such a core. This procedure is repeated according to a Monte Carlo technique, choosing at random as many "random cores" as necessary. In this way actual probability and distribution curves for the Y are obtained. By intersection of the distribution curves with a certain confidence level the expected Y^+ values are obtained. This procedure is programmed for the IBM-7090 computer. The code, named HYTHEST, evaluates the correction factors relative to a PWR or a BWR reactor core. The first results obtained (somewhat unexpected, at least in the frame of the conventional approach way of reasoning) can be so summarized: the most probable values of the Y's do not always correspond to the nominal values (the deviations are stronger for highly non-linearly dependent variables (e.g., maximum fuel temperature)); the distribution curves of the Y's depend on assumed neutron flux shapes, so that, for instance, the exit enthalpy variations are larger if the axial flux shape is more peaked; and the correction factors obtained with the "spot model" statistical approach are generally smaller by an order of magnitude than that given by the corresponding conservative method. However this last rule does not hold for some non-linearly dependent variables. A detailed comparison between the conservative method and the "spot" model is carried out. (auth)

Materials Testing

Refer also to abstract 36477.

35997 (IITRI-B6001-5) HIGH-TEMPERATURE OXIDATION PROTECTIVE COATINGS FOR VANADIUM-BASE ALLOYS. Final Report, September 13, 1962–August 12, 1963. Larry I. Kane, John J. Rausch, and F. C. Holtz (Illinois Inst. of Tech., Chicago. IIT Research Inst.). Sept. 12, 1963. Contract N600(19)-59182. 51p.

Basic pack-siliconizing parameters — time, temperature, activator concentration, and location — and edge and surface preparation techniques were optimized for thin 0.020- to 0.030-inch sheet with respect to static and dynamic oxidation life, coating thickness, and coating adherence during elastic and plastic deformation. Processing for 8 hours at 2150°F with either an isolated or mixed activator-silicon pack yields coatings of optimum thickness, i.e., 2.25 to 3 mils. Static oxidation life of V–60 wt % Nb–1 wt % Ti-coated under these conditions is greater than 500 hours at 2200°F. Sixteen other niobium–vanadium-base alloys containing various refractory metal additions were pack-siliconized and oxidation tested. Minimum static oxidation life was established at 150 hours at 2200°F for each of the alloys. Oxidation behavior of compounds based on $(V,Nb)Ni_2$, $(V,Nb)Ni_3$, $(V,Nb)Co_2$, and $(V,Nb)Co_3$ were studied at 2000 and 2200°F. The cobalt-containing compounds had relatively poor oxidation resistance. Compounds of V–Nb–Ni were flame-sprayed on V–60 wt % Nb–1 wt % Ti, but excessive porosity caused rapid failure in 2000° and 2200°F air. (auth)

35998 (LADC-5760) REMOTIZED MICROHARDNESS TESTER. Mahlon T. Wilson and Linas L. Thorn (Los Alamos Scientific Lab., N. Mex.). [nd]. Contract [W-7405-eng-36]. 10p. (CONF-187-6)

For Presentation at American Nuclear Society Meeting, New York, Nov. 1963.

Two Model AK Kentron Microhardness Testers were remotized for use in high radiation fields. One of the machines is mounted in an alpha box for use on irradiated plutonium specimens. Unique features of these machines are: the use of a lazy-susan for carrying the dead weight loads, a stage that holds a specimen by the polished surface so that no vertical stage motion is required, ability to remotely change the microscope illumination lamp, and use of geared down coarse focus for fine focus adjustment. (auth)

35999 (NAA-SR-Memo-7769) EVALUATION OF EDDY-CURRENT TESTING OF FINNED APM TUBING. D. B. West (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Sept. 28, 1962. Contract [AT(11-1)-Gen-8]. 6p.

The feasibility of an eddy-current test of APM tubing was established. Using equipment designed for development of testing techniques, voids, and inclusions located in the tubing wall with cross-section areas less than 2 mils in diameter and 5 mils long may be detected. Specimens taken from sample tubing and submitted for metallographic examination supported results obtained from eddy-current testing. (auth)

36000 (ORNL-TM-629) DROP TESTS PERFORMED ON THE FRANKLIN INSTITUTE'S 1/4-SCALE MODEL OF A 40-TON CASK. L. B. Shappert (Oak Ridge National Lab., Tenn.). Aug. 19, 1963. Contract [W-7405-eng-26]. 33p.

Results are presented of five impact tests on a $\frac{1}{4}$ scale model of a 40-ton cask. The tests included drops onto a beam and a piston. Important dimensional measurements were made before and after each drop. Accelerometer readings were made by key positions. (D.L.C.)

36001 STUDY OF NONDESTRUCTIVE TESTING USING A 15 Mev INDUSTRIAL BETATRON. Masatoshi Kobayashi, Hiroshi Hara, Sho Maeda, Kiyoshi Nakajima, and Shozo Kurata. Tokyo Metropolitan Isotope Centre Ann. Rept., 1: 1-9(1962). (In English)

A 15-Mev industrial betatron for nondestructive inspection was examined for some basic characteristics of the high energy x-ray beams generated in the apparatus and for some techniques of photographing. An ionization chamber and various kinds of films were used for measurements. First, the energy spectrum, half value layer for iron, and effective energy, for the x-ray beams were determined. Moreover, the intensifying indexes and the sensitivity for defects were determined for various kinds of photographing methods and the conditions and mutual relations between them are discussed. Also, practical exposure charts for the betatron were determined. (P.C.H.)

36002 SOME STUDIES ON SHRINKAGE PIPES IN KILLED STEEL INGOTS BY USING AN INDUSTRIAL BETATRON. Masatoshi Kobayashi, Shozo Kurata, Hiroshi Hara, Kiyoshi Nakajima, Hiroshi Iijima, Tetsuo Yamaguchi, and Koichiro Miyauchi. Tokyo Metropolitan Isotope Centre Ann. Rept., 1: 10-18(1962). (In Japanese)

Various defects of products that arise from faults in the ingot, the original material, especially on the killed-steel ingot for the pipe of large diameter, relations between the

types of shrinkage pipes, casting conditions, and the quality of rolled products were investigated. It was proved that betatron radiography contributes greatly to such studies. (P.C.H.)

36003 FUNDAMENTAL STUDY ON WEAR OF METALS BY USING RADIOISOTOPE. Masatoshi Kobayashi, Yasuhiro Horiguchi, and Ichiji Okawa. Tokyo Metropolitan Isotope Centre Ann. Rept., 1: 19-24(1962). (In Japanese)

The transient wear of radioactive specimens (pure copper, Sn–Sb–Cu alloys, and chromium plated on steel) under various loads was observed. Spindle oil No. 60 was used as the lubricating oil. A NaI scintillation crystal ($1\frac{3}{4}'' \times 1''$) connected with a conventional photomultiplier tube was used as the detector. The minimum detectable limit was a wear of $10^{-5} \sim 10^{-6}$ mg. On the radioactive copper specimen the initial wear during the first 50 minutes reached 75% of the total wear that occurred during 200 minutes under a load of 1000 rpm and 5 kg. The initial wear of radioactive Sn–Sb–Cu alloy specimens reached to 50% of the total wear that occurred during 50 minutes under a load of 1000 rpm and 5 kg, during the first 10 minutes. (P.C.H.)

GEOLOGY, MINERALOGY, AND METEOROLOGY

36004 (BNL-784) THE USE AND MISUSE OF THE ATMOSPHERE. Maynard E. Smith (Brookhaven National Lab., Upton, N. Y.). June 1963. Contract AT(30-2)-Gen-16. 17p. (BNL-T-298)

Brookhaven Lecture Series No. 24, Feb. 13, 1963.

The history of air pollution problems is reviewed. Atmospheric processes that affect air pollution; factors affecting the size, dispersion, and removal of particles and gases from the atmosphere; and the sources and scope of present-day atmospheric pollution by industry are discussed. The character of smoke-fog combinations in heavily industrialized areas of the U. S. and London, England, and the contribution of debris from nuclear explosions to world-wide atmospheric pollution are described. The control of air pollution by industries through stack disposal and other methods is evaluated. (C.H.)

36005 (BNL-6451) "AGES" OF THE SIKHOTE ALIN METEORITE. David E. Sisher (Cornell Univ., Ithaca, N. Y. and Brookhaven National Lab., Upton, N. Y.). [1962]. Contract AT-30-2-GEN-16. 5p.

The potassium-argon age of the Sikhote Alin iron meteorite was determined. The value is $1.7 \pm 0.2 \times 10^9$ years. Previous lead data suggest an age of 4.6×10^9 years. The date of solidification may be the sum of these two ages. (auth)

36006 (DASA-1303) PROJECT STAR DUST. Quarterly Report No. 3. James P. Friend, Herbert W. Feely, Edwin L. Fisher, and Benjamin Davidson (Isotopes, Inc., Westwood, N. J.). Feb. 1, 1962. Contract DA-49-146-XZ-079. 65p. (AD-294640)

Meteorological study of atmospheric mixing and transfer processes has continued and progress was made on the development of the Star Dust model of atmospheric mixing and transfer. Data on the stratospheric distribution of W^{185} are being used as the first test of the accuracy of the meteorological parameters adopted. Star Dust filter sampling of stratospheric air has continued and, since September 30, 1962, debris from the 1961 Soviet test series has been encountered in the Star Dust sampling corridor. The analytical program has been modified to gain as much information as possible about this Soviet debris, because it constitutes an additional tracer for stratospheric meteorology. It was all injected, originally, into the northern polar stratosphere during the reasonably short intervals, September to November 4, 1961, and its southward spread into the troposphere has been observable virtually unhindered by the presence of debris from previous tests. The debris which was present in the stratosphere before the 1961 Soviet tests began was quite old and, for the most part, easily distinguishable from the Soviet debris. It has been especially illuminating to compare the characteristics of the southward movement of the Soviet debris with the characteristics of the northward movement of W^{185} observed during the High Altitude Sampling Program. (auth)

36007 (DASA-1304) PROJECT STAR DUST. Quarterly Report No. 4. James P. Friend and Herbert W. Feely (Isotopes, Inc., Westwood, N. J.). May 1, 1962. Contract DA-49-146-XZ-079. 68p. (AD-294641)

Project Star Dust has as its aim the construction of a model of stratospheric mixing and transport. Data from the high altitude sampling program and other studies of worldwide fallout are being used in constructing the model, but to obtain additional data a program of filter sampling of stratospheric radioactivity is also being carried out. (auth)

36008 (EGG-B-2516) ON SITE RADON STUDIES IN SURFACE SOILS— PROJECT VELA. Final Report. (Edgerton, Germeshausen and Grier, Inc., Santa Barbara, Calif.). Dec. 6, 1962. Contract AF49(638)-1110. 93p. (AD-294019)

The influence of the seismic wave produced by an underground explosion on the naturally occurring Rn^{222} and Rn^{220} concentrations of the surface soil layers and on changes in the Rn flux at the earth-air interface were investigated as to applicability in the location of the epicenter of an underground nuclear explosion. Factors affecting the concentration of Rn^{222} and thoron (Rn^{220}) in the interstices of the soil are reviewed. The effects of disturbances of soil or rock caused by underground nuclear detonations on the normal release of Rn^{222} and Rn^{220} are discussed. Results are reported from measurements of Rn^{220}/Rn^{222} ratios and Rn flux at various soil depths and distances from a series of underground explosions. It is concluded that the Rn-flux technique may be incorporated into a system of underground nuclear inspection. (C.H.)

36009 (ORNL-TM-597) THE GEOLOGY OF A PORTION OF THE HUTCHINSON SALT MEMBER OF THE WELLINGTON FORMATION IN THE MINE OF THE CAREY SALT COMPANY, LYONS, KANSAS. T. F. Lomenick (Oak Ridge National Lab., Tenn.). Sept. 3, 1963. Contract W-7405-eng-26. 12p.

An investigation of rock conditions in the Lyons Mine of The Carey Salt Company revealed that the first 115 to 135 in. of the salt section below the floor in the westernmost portions of Entries 7 and 9 contains between 20 and 40% shale. A second shaly zone, approximately 40 to 50 in. thick, is present generally from about 220 to 235 in. below the floor. Four separate shaly zones, each a few inches in thickness, occur in the first 250 in. of salt rock above the mine roof. (auth)

36010 (PNE-234P) STABILITY OF CRATER SLOPES. W. C. Sherman, Jr. and W. B. Steinriede, Jr. (Waterways Experiment Station, Vicksburg, Miss.). Apr. 1963. Project SEDAN. 35p.

Accurate determination of the physical properties of the alluvium at the SEDAN site was difficult since only a few representative samples were available. Complex lithology of the alluvium and the variable distribution of caliche and other zones of cementation throughout the sampled interval compound the problem. Regional data from Yucca Flat as well as observations of the alluvium at the project site show that an increase in density occurs with depth, probably due to cementation, or compaction, or both. Surface seismic measurements made by the U. S. Geological Survey suggest an increase in density with increasing depth in parts of northern Yucca Flat. Although the results of the geophysical logs shown do not indicate the presence of a well-defined stratigraphic sequence, the Densilog appears to substantiate the results of the laboratory density determinations which indicate an increase in natural density and also in relative density to a depth of about 150 ft, below which the natural density and relative density appear to be constant to the depth investigated. The data presented provide information on the geologic and soil

conditions in the project area and, together with the pertinent engineering properties, provide a basis for estimating the changes in these properties resulting from detonation of a nuclear explosive in the project area. These data will also enable an estimate to be made of the degree of stability of the crater slopes. (auth)

36011 RADIOACTIVE FALLOUT AND AIR MOTION IN TAIWAN. Shih-chong Lu (Taiwan Weather Bureau, Taipei, China). Chinese J. Phys. (Taiwan), 1: 17-20(Apr. 1963).

Daily measurement of fallout air activity and deposited activity at Taipei, Taiwan from Jan. 1, 1959 to Dec. 31, 1962, is given as monthly means, for days with and without obvious rain water. It seems that the velocity of deposition may be influenced by inversion of temperature, and that the deposited materials become small with time. On the other hand, the amount of fallout is likely to be very much influenced by an air mass that comes from the mainland and to be frequently greater behind a cold front. (auth)

36012 CONCEPTS OF GENESIS OF SANDSTONE-TYPE URANIUM ORE DEPOSITS. Hans H. Adler (Div. of Raw Materials, AEC, Washington, D. C.). Econ. Geol., 58: 839-51(Sept.-Oct. 1963).

Although the sources of uranium in sandstone-type ores are in most cases obscure, the formation of the ore deposits can be attributed on the basis of sulfur isotopic data to the precipitating action of hydrogen sulfide of bacteriological origin. In some areas deposition has been related heretofore to natural gas, but the isotopic evidence does not support this origin. Certain fracture-controlled and breccia-pipe deposits also show isotopic evidence of having been formed under conditions similar to those existing for the sandstone-type ores. Geochemical relations suggest that salt-dome structures as well as fractures transecting carbonaceous sediments may be favorable sites for uranium accumulation. Certain features provide a unique basis for appraising the uranium potential of salt domes. The sulfur isotopic data reflecting bacteriological involvement in uranium deposition in no way refute the possibility that the uranium was initially derived as an igneous emanation, but the tuff-leach mechanism may provide a more favorable model on which to base exploration in some areas of the U.S.A. The concepts discussed may aid greatly in developing models of uranium distribution which may be applied in future exploration. (auth)

36013 URANIUM, THORIUM AND POTASSIUM IN ECLOGITIC ROCKS. K. S. Heier (Australian National Univ., Canberra). Geochim. Cosmochim. Acta, 27: 849-60(Aug. 1963).

Radiometric determinations of Th, U, and K in 6 eclogites from metamorphic environments, and in 13 eclogitic rocks from volcanic environments are given. Good agreement was found between radiometrically and flamephotometrically determined potassium contents. The most important conclusions made from this study are: the Th/U ratio in eclogitic rocks is comparable to tholeiitic basalts of orogenic type; eclogites are derived from the upper portion of the mantle; and the data indicate a more complex history of formation of the examined eclogites from metamorphic environments as compared with those from volcanic environments. (auth)

36014 ON THE RELATION BETWEEN RADIOACTIVE RAINFALL AND METEOROLOGICAL CONDITIONS. N. Murayama (Japan Meteorological Agency, Tokyo). Geophys. Mag. (Tokyo), 31: 147-56(Mar. 1962).

Examinations were made to see whether or not variability of the specific radioactivity in individual rainfalls would occur in relation to meteorological conditions. A trend was found that seems to indicate that the high specific radioactivity in precipitation occurs in association with the polar air mass, the passage of upper troughs, and the cold frontal rainfall. It seems that the associations could be explained as due to an inverse correlation between specific radioactivity and amount of rainfall. (Public Health Eng. Abstr., 43: No. 8)

36015 EFFECT OF MOISTURE CONTENT AND SOIL TYPE ON SELF DIFFUSION OF Rb^{86} IN SOILS. I. J. Graham-Bryce (Univ. College of North Wales, Bangor). J. Agr. Sci., 60: 239-44(Apr. 1963).

Self-diffusion coefficients (D) for Rb^{86} ion were measured in a heteroionic Lower Greensand soil over a wide range of moisture contents at three different compactions. The moisture content is shown to have a considerable effect on the value of D, a rapid rise in the value of D taking place between 5 and 10% moisture content. It is shown that this effect is not simply due to the increased volume of water-filled pore space at higher moisture contents, and other possible factors which could influence the shape of the D/moisture content curve are discussed. Values of D for Rb^{86} in eight other soils at pH two are also reported, but no simple correlation with any of several soil properties measured could be found. An average D value of 1.0×10^{-7} cm^2/sec was derived for Rb^{86} in moist Ca-dominated soils. The range of D values in the nine soils tested was 0.71 to 1.55×10^{-7} cm^2/sec. It is concluded that the rapid rise in the value of D at 5-10% moisture content may correspond with the establishment of a continuous aqueous diffusion system. At lower water contents the pores which are occupied may be well isolated, thus preventing continuous movement by diffusion, while at moisture contents above 10% a large proportion of the added water may be filling wide air pockets connected by smaller pores. At low moisture contents the diffusing cations may be confined to pores so narrow that the effects of the surface charges of the soil particles (in the form of diffuse electrical double layers) extend throughout the pore. At higher moisture contents ions would diffuse in wider pores where they would not be confined to the double layer. It is pointed out that the rapid rise of D occurs in the region of pH 4.2, that is at the ~ tension associated with the permanent wilting point, suggesting that a substantial decrease in the mobility of plant nutrients in the soil may be associated with wilting. (BBB)

36016 SCIENTIFIC REPORT. ISSUE 8. MINING GEOPHYSICS (PROCEEDINGS OF ALMALYK CONFERENCE). Uch. Zap., Sredneaz. Nauchn.-Issled. Inst. Geol. i Mineral'n. Syr'ya, No. 8, 1-244(1962). (In Russian)

Thirty papers are included on mining geophysics. The papers deal with radiometric methods of prospecting and magnetometric and gravimetric studies of deposits. (R.V.J.)

36017 USE OF RADIOACTIVE SOURCES IN MEASURING CHARACTERISTICS OF SNOWPACKS. Henry W. Anderson, Philip M. McDonald, and Lloyd W. Gay (Pacific Southwest Forest and Range Experiment Station, Berkeley, Calif.). 9p. (CONF-85-1; PSW-11)

From American Meteorological Society Meeting, Washington, D. C., Apr. 1963.

Commercially available gamma and neutron probes were tested for their ability to measure snow density, ice lenses, and the thermal quality of individual layers in the snowpack. The probes were lowered into an aluminum access tube inserted into the snow, and the gamma and neutron counts taken at successive 6 in. depths. A total of

1100 samples (gamma and neutron counts) were taken at 31 forest sites during the spring of 1962. From these measurements, the relationship of gamma and neutron counts to snowmelt was also tested. (P.C.H.)

36018 APPARATUS FOR OBTAINING SAMPLES FROM THE WALLS OF BOREHOLES OR CHANNELS. (to Electricite de France Service National). British Patent 932,769, July 31, 1963. Priority date Feb. 15, 1960, France.

An apparatus for removing samples from the wall of a narrow bore hole or channel at any desired depth is patented. A casing, which slides freely along the channel, contains a motor with its shaft parallel to the axis of the casing. A sample-obtaining member revolves about an axis perpendicular to the motor shaft and moves radially in or out. A worm gear transforms the rotation of the shaft into rotation of the sample-obtaining member, which is connected to a tool-carrying pinion. A mechanism simultaneously controls the rotation and progression of the sample-obtaining member. The design of the apparatus is described in detail. (M.P.G.)

HEALTH AND SAFETY

Refer also to abstracts 35331, 35332, 35333, 35344, and 36926.

36019 (AE-119) MEASUREMENT OF GAMMA RADIOACTIVITY IN A GROUP OF CONTROL SUBJECTS FROM THE STOCKHOLM AREA DURING 1959–1963. I. O. Andersson, I. Nilsson, and K. Eckerstig (Aktiebolaget Atomenergi, Studsvik, Sweden). Aug. 1963. 19p.

Repeated measurements of the γ radioactivity in a group of control subjects were made since June 1959, using a whole-body counter scintillation spectrometer. The body contents of Cs^{137} and K^{40} and their trends with time were determined. The Cs^{137} values were compared with the results from measurements of the fallout rate of Cs^{137} and the concentration of Cs^{137} in milk. The control group study was carried out to obtain information about the γ radioactivity situation in the general population. Such an investigation is necessary in order to measure occupational contamination at low levels. (auth)

36020 (AECL-1797) IODINE-131 CONTENT OF CANADIAN MILK DURING 1961. W. E. Grummitt and P. R. Kamath (Atomic Energy of Canada Ltd., Chalk River, Ont.). May 1963. 8p.

The concentration of I^{131} was determined in milk collected at Chalk River and other areas in Ontario and Quebec. The average concentration for 1961 was 17 pc/l, while the maximum during November of that year was 250 picocuries per litre. The yearly total is 13% of the acceptable maximum specified by the Medical Research Council (UK). Analytical methods for determining I^{131} by γ spectrometry are described. (auth)

36021 (AERE-R-4254) THE EFFECT OF ANTISTATIC AGENTS ON FABRICS WOVEN FROM SYNTHETIC FIBRES. W. J. Colclough, A. J. Smith, and H. Wells (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). July 1963. 15p.

Laboratory and field evaluations of protective clothing made with staple polyester fibre suggest that appreciable savings can be made in replacements and overall laundry costs, e.g., washing schedules, drying, and finishing times. An intrinsic disadvantage of synthetic fibres is their tendency to develop static electrical charges and an evaluation is made, by surface resistivity measurements, of antistatic agents. The effect of antistatic treatments on subsequent radiological decontamination procedures was determined on samples of fabric contaminated with soluble and insoluble radioactive media. It is concluded that synthetic fibres can be readily and efficiently treated to reduce their surface resistivity to an acceptable level, and that such treatment has no adverse effect upon the laundering process. (auth)

36022 (AERI-H/R-1) ON THE OBSERVED FEATURES OF FALLOUT AND AIR ACTIVITY AT GROUND LEVEL. Chae Shik Rho (Atomic Energy Research Inst., Seoul, Korea). Apr. 1, 1963. 15p.

Some relationships between radioactive fallout and meteorological patterns within the troposphere are considered. Precipitation is reconfirmed as a principal process of scavenging and downward transport of dust. The surface radioactivity was found to depend on the air masses and frontal passages at the surface, and on the position of the trough and core axis of the jet stream aloft. (auth)

36023 (ANL-6736) ENVIRONMENTAL RADIOACTIVITY AT ARGONNE NATIONAL LABORATORY. Report for the Years 1960 and 1961. J. Sedlet and F. S. Iwami (Argonne National Lab., Ill.). June 1963. Contract W-31-109-eng-38. 61p.

The results of environmental monitoring for 1960 and 1961 at Argonne are given. The radioactive content of the environment was measured by radiochemical analysis, total activity measurements, and gamma spectrometry of several types of natural materials collected on the ANL site and from locations up to 100 miles from the Lab. Special attention was given to air and water. In 1960 and the first 3 quarters of 1961, fallout activity in the environment was at the lowest level since Jan. 1953. On Sept. 14, 1961, the beta activity in air increased sharply and remained at a relatively high level for the remainder of the year. Radioactivity originating at Argonne and leaving the site was found only in air during March 1961, and in most Sawmill Creek water samples collected during the reporting period. The average total activities in samples of water, material from the beds of lakes and streams, soil, and plants during 1960 and 1961 are tabulated. For comparison, the results obtained from 1952 through 1961 are also included. (P.C.H.)

36024 (BIO/26/62) DATA ON ENVIRONMENTAL RADIOACTIVITY COLLECTED IN ITALY (JANUARY–JUNE 1962). (Italy. Comitato Nazionale per l'Energia Nucleare, Rome). Oct. 1962. 363p.

Data on radioactivity in air and water samples, Sr^{90} and Sr^{89} in content in samples of animal bones and grass, Sr^{90}, Cs^{137}, and Sr^{89} in milk and fallout samples, and drinking waters, Sr^{90} in soil, and beta radioactivity content in sea fauna are tabulated. (P.C.H.)

36025 (CLOR-17) SUPERVISORY ACTIVITIES OF THE ESTABLISHMENTS CONTROL DIVISION OF THE CLOR AND RADIOLOGICAL PROTECTION CONDITIONS IN THE RADIOISOTOPE LABORATORIES IN POLAND IN THE YEARS 1960–1961. T. Musiałowicz, St. Dyź, and J. Jakubiak (Poland. Biuro Pelnomocnika Rzadu do Spraw Wykorzystania Energii Jadrowej. Centraline Laboratorium Ochrony Radiologieznej, Warsaw). 1963. 30p.

Results are reported from a survey made in 1960 and 1961 of radiological protection conditions in laboratories in Poland using radioisotopes and other radiation sources. A growth in the number of laboratories using radioisotopes and improved radiation protection practices was noted. (C.H.)

36026 (CONF-32-2) RELATIVE HAZARD OF THE VARIOUS RADIOACTIVE MATERIALS. Karl Z. Morgan, W. S. Snyder, and M. R. Ford (Oak Ridge National Lab., Tenn.). [1963]. Contract [W-7405-eng-26]. 38p.

From Health Physics Society 7th Annual Meeting, Chicago, June 1962.

An equation is given for the relative hazard, H, of various radionuclides under uniform working conditions. H is defined as the ratio of the average μC/cc inhaled in the working area to the maximum permissible concentration, MPC, of the radionuclide for occupational exposure. The variation of H is discussed in relation to such parameters as radioactive and biological half lives of the radionuclides,

fractional retention, dilution factors, specific activity, energy, RBE, relative damage factor, n, mass of the critical organ, and the maximum permissible dose to the critical organ. Comparisons are made with values of H obtained by this and other investigations. The values of H obtained by this method appear to be consistent with estimates from operational experience. A table of values of specific activity, $(MPC)_c$ and relative hazard, H, is given for the radionuclides listed in ICRP Publication No. 2, plus values for a number of additional transuranic elements not previously listed by the ICRP. (auth)

36027 (LADC-5863) SAFETY IN CRYOGENIC OPERATIONS. Roy Reider (Los Alamos Scientific Lab., N. Mex.). [nd]. Contract [W-7405-eng-36]. 3p. (CONF-176-3).

From Cryogenic Engineering Conference, Boulder, Colo., Aug. 1963.

Some accidents that resulted from improper equipment and procedures and from insufficient employee instruction and safeguards are described. (D.C.W.)

36028 (NP-13035) RADIOACTIVITY IN DRINKING WATER IN THE UNITED KINGDOM, 1962 RESULTS. (Gt. Brit. Ministry of Housing and Local Government, London; Gt. Brit. Secretary of State for Scotland. Scottish Development Dept., Edinburgh; and Northern Ireland. Ministry of Health and Local Government, Belfast). 1963. 24p.

Data are presented on the content of Sr^{90} and Cs^{137} in samples of drinking water collected throughout Great Britain during 1962. (C.H.)

36029 (NSEC-79(Pt.I)) PHYSICAL AND CHEMICAL STATES OF IODINE IN FALLOUT. PART I. Status Report No. 1. R. C. Koch and B. Keisch (Nuclear Science and Engineering Corp., Pittsburgh). Nov. 1, 1962. Contract AT(30-1)-3082. 21p.

A research program is being conducted to study the distribution of radioiodine among the possible physical and chemical states in fallout. Experiments were made on the leaching of I^{131} from airborne particulates and on the distribution of soluble I^{131} among the different chemical states in precipitation. Analytical methods which were developed for the experiments are described. Results of the experiments are given; they show that the soluble I^{131} is present predominantly in the iodine-iodine state and that only minimal fractions of I^{131} are present as periodate. (D.L.C.)

36030 (NSEC-79(Pt.II)) PHYSICAL AND CHEMICAL STATES OF IODINE IN FALLOUT. PART II. Status Report No. 1. B. Keisch and R. C. Koch (Nuclear Science and Engineering Corp., Pittsburgh). Nov. 1, 1962. Contract AT(30-1)-3082. 15p.

It is shown that there is a slight difference in radioiodine release from particulates by leaching with water or 0.1 N HCl and that this difference disappears with finer particles. The particulates known to adhere readily to foliage and, hence, likely to be ingested by animals are in the size range passing the 170 mesh sieve. These finer particles release I^{131} most readily and, therefore, present the greatest biological hazard. Since the finer particles are also as readily leached by water as by acid, the situation becomes somewhat complicated. If these particulates are exposed to lengthy precipitation, essentially all of the biologically available I^{131} may be released prior to ingestion. In this case, the I^{131} in the ingested particulates may represent a substantially reduced potential hazard. The hazard represented by the precipitation now containing large amounts of I^{131} in a soluble form is determined by its fate, i.e., whether this solution enters the ground directly where I^{131} may be harmlessly absorbed or whether it is collected in a drinking water supply system. That fraction of the particulate debris which appears in surface water may be exposed to water-leaching to an extent sufficient to convert up to nearly 40 percent of the I^{131} to a soluble form. Thus, ingestion of these particulates by animals in drinking water may represent a distinctly reduced potential hazard relative to direct ingestion of particulates attached to foliage. The soluble fraction of I^{131} may be extensively diluted. However, this fraction may contain I^{131} in a form amenable to direct assimilation by animals or humans. The extent to which the soluble I^{131} represents a hazard depends on the configuration or dynamics of the diluting system. (auth)

36031 (NSEC-84) PHYSICAL AND CHEMICAL STATES OF IODINE IN FALLOUT. Status Report No. 2. B. Keisch and R. C. Koch (Nuclear Science and Engineering Corp., Pittsburgh). Feb. 1, 1963. Contract AT(30-1)-3082. 30p.

Results are reported of experiments on the leaching behavior of I^{131} from airborne particulates, the chemical state distribution of leached I^{131}, the distribution of I^{131} between the solid and liquid phases in precipitation, and the leaching behavior and chemical distribution of I^{131} from the precipitation solids. The airborne particulates show consistent behavior: constant leaching rate and degree, average I^{131} distributions of 65.5, 29.5, and <5% for the reduced, iodate, and periodate states, respectively. On the other hand, precipitation shows variable behavior, probably due to the particle-water contact. The program for I^{129} measurements is described briefly. (D.L.C.)

36032 (ORNL-TM-679) BNL-KILOROD PROGRAM: HEALTH PHYSICS CONTROL AND DATA COLLECTION. F. W. Davis and E. C. Moncrief (Oak Ridge National Lab., Tenn.). Sept. 6, 1963. Contract [W-7405-eng-26]. 17p.

A program is outlined for obtaining data on activity buildup in $ThO_2-U^{233}O_2$, containing 38 ppm U^{232}, as it is processed in the Kilorod Facility and data on gamma dose rates and doses to personnel from the U^{232} daughters. Sampling at the various stages in the process, followed by gamma- and alpha-spectrometry, will be used to follow growth and distribution of U^{232} daughters in the processing lines. Ion chambers inside the shielding will be used to monitor dose rates at the same points in the processing for which calculations were made. Film badges and rings will be used to obtain data on personnel exposure, both for total exposure in a process line and exposure at individual operating stations. (auth)

36033 (PAEC(D)PH634) A STUDY OF THE SHIELDING EFFECTIVENESS OF THE PARC COBALT-60 GARDEN. J. O. Juliano, R. H. Ibarra, O. V. Gabriel, M. G. Natera, E. E. Reyes, and G. J. Rodriquez (Philippines. Atomic Energy Commission. Atomic Research Center, Manila). June 1963. 15p.

Shielding requirements for a γ irradiation facility for use in plant studies are reviewed. The facility has a 150-C Co^{60} source placed in the center of the area. The source can be raised to a maximum height of 3 ft above the ground and is located near other working areas. A concrete, earth, and adobe wall, 6 ft high and 6 ft thick at the base decreasing to 4 ft thick at the top surrounds the facility. Preliminary measurements of scattered radiations made using a 6.6-C Co^{60} point source indicated that additional shielding is needed. (C.H.)

36034 (PAEC(D)PH636) RETENTION OF RADIOACTIVE CONTAMINATION BY SURFACING MATERIALS.

Pericles T. Meneses, Asterio Palma, and Raymundo Pilapil (Philippines. Atomic Energy Commission. Atomic Research Center, Manila). June 1963. 6p.

The decontamination properties of 8 commercially available coatings for table tops and fume hoods for use in radioisotope laboratories were evaluated. The radioisotopes used were Fe^{55-59}, Co^{60}, Cs^{137}, Na^{22}, P^{32}, Sr^{89}, and mixed fission products. The decontamination procedure consisted of washing once with water, 3 times with a detergent solution (Tide), once with a complexing agent (a 0.1 M solution of EDTA), and scouring with a scouring agent (a 50% Henlex solution). Lucite, polyethylene, and Fil-Hispano tiles were found to be the materials most easily decontaminated by the procedure used. (C.H.)

36035 (TID-17857) ALPHA MONITORING PROCEDURES FOR EBR-I MARK IV PLUTONIUM FUEL ELEMENTS. W. B. Grant (Argonne National Lab., Ill.). Nov. 1962. Contract W-31-109-eng-38. 6p. (UAC-7050)

A brief description is given of the equipment and procedures used in monitoring the finished EBR-I Mark IV fuel elements prior to loading into the reactor, for possible contamination. Two Eberline PAC-1A gas proportional monitors were mounted facing each other in an air hood and used to monitor the fuel elements in an upright position. The performance of the monitoring system was satisfactory. The found contamination was confined to the top girth weld zone of the elements and was apparently well fixed in the weld. (D.L.C.)

36036 (TID-19297) THE DIRECT MEASUREMENT OF LOCAL ABSORBED DOSE PRODUCED BY RADIATION BEAMS IN TISSUE MATERIALS. Annual Progress Report, July 1, 1962–June 30, 1963. John S. Laughlin (Sloan-Kettering Inst. for Cancer Research, New York). July 18, 1963. Contract AT(30-1)-1451. 9p.

An all carbon calorimeter with modified recording circuit was calibrated and used to calibrate a secondary standard for high energy electrons. The G value of the Fricke ferrous sulfate system was determined by exposure in a geometry similar to that of the local absorbed dose microcalorimeter. A portable field calorimeter that can be transported from one laboratory to another and still give reliable fundamental calibrations of absorbed dose is now virtually completed. A transmission monitor ionization chamber that is positioned directly on either the calorimeter, ferrous sulfate block, or extrapolation chamber was constructed and put into use. The transmission ionization chamber allows integration of the high energy electron, or other radiation beam, passing through it. Since it is located in a fixed geometry directly above the calorimeter or secondary instrument, and since its sensitive region is essentially the same as that of the microcalorimeter, it has allowed for an increase in the accuracy of reproducibility of the monitoring of various experimental runs. (P.C.H.)

36037 (TID-19365) AIR CLEANING. Progress Report, July 1, 1962–December 31, 1962. (Harvard Univ., Boston. Air Cleaning Lab.). Contract AT(30-1)-841. 33p.

Progress is reported in investigations of air cleaning procedures. Results are included from investigations of calcination and off-gas scrubbing; a critical review of design features of a rare-gas collector proposed for use in the PL-2 reactor; decontamination of enclosed spaces containing dispersed gases or particulates by the injection of stable, water-soluble, chemical foams; an evaluation of the effectiveness of activated charcoal and metal fibers for the removal of aerosols containing iodine isotopes from air; iodine tranfer mechanisms within bubbles; the design of an incineration facility for radioactive wastes; and the evaluation of special gas cleaning equipment. (C.H.)

36038 (TO-B-61-34) ATTENUATION OF COBALT-60 RADIATION FROM A SOURCE DISTRIBUTED AROUND A CONCRETE BLOCKHOUSE. John F. Batter and Albert W. Starbird (Technical Operations, Inc., Burlington, Mass.). June 15, 1961. 19p.

Two radiation-shielding experiments were performed upon a simple blockhouse structure. The blockhouse was exposed to a simulated fallout field, and the radiation penetrating the structure was measured. The radiation field was produced by circulating a sealed cobalt-60 source through polyethylene tubing predistributed over an octant centered on the test building. Experimental details are described and results tabulated. (auth)

36039 (UCRL-7355) HAZARDS CONTROL QUARTERLY REPORT NO. 12, JANUARY–MARCH 1963. (California. Univ., Livermore. Lawrence Radiation Lab.). Contract W-7405-eng-48. 38p.

A semiautomatic reader is described that was developed for use with lithium fluoride dosimeters. Developmental work on a new type of personnel γ dosimeter is reported. A technique was developed for the determination of U^{235} collected in two types of filter medium. A monitor system for sewage is described and a method for determining Be contamination on ceramics is discussed. A high expansion foam for fire control with a minimum of water was developed, an improvement in the design of half-mask respirators allows better portability and increased efficiency of operation, and a sprayable polyurethane safety flooring system was developed and tested for use in high-explosive handling areas. (C.H.)

36040 THE IODINE CONTENT OF SWEDISH DAIRY MILK. G. Widstroem, C.-B. Thorell, and B. Aberg (Stockholms Lans Centrallasarett, Danderyd and Royal Veterinary Coll., Stockholm). Acta Chem. Scand., 17: Suppl. 1, S238-40(1963). (In English)

The Swedish dairy milk I^{127} content was determined and evaluated with regard to its protective effects against thyroidal uptake of I^{131} from fall-out. (auth)

36041 BIOLOGICAL ASPECTS OF NUCLEAR WEAPONS. Cyril L. Comar (Cornell Univ., Ithaca, N. Y.). Am. Scientist, 50: 339-53(June 1962).

A discussion is provided of various aspects of nuclear weapon testing and the resultant fallout, nature of fission products and extent of contamination of the biosphere, acute and longterm biologic effects of radiation, and means of controlling and reducing the hazards of fallout to man. The question as to whether diet or food technology should be modified to decrease the intake of radioactive contamination is considered, and it is concluded that it would be erroneous to supplement diets with stable Ca which theoretically reduces Sr retention, to give I drops to block thyroid uptake, or to reduce milk intake. It is suggested that the chance of harmful effects by such modification of diets far outweighs the chance of beneficial effects. It is suggested that without milk, the human body would contain three to five times more Sr^{90} than at present due to Ca incorporation from plant sources. The question of whether or not consideration should be given to the decontamination of land and of foodstuffs is also reviewed, and possible remedial measures for decontamination of land are identified. General conclusions derived from the survey are: any use of nuclear energy or radiation involves a biological cost which must always be weighed against the benefits expected; controlled peacetime use of nuclear energy yields benefits far

in excess of biological costs; the biological cost of past weapons tests of about 100–150 megatons of fission is small enough so that individuals need have no anxiety concerning health hazards; the factor of biological cost should be a minor one in reaching decisions about resumption of atmospheric weapons tests; other factors—military, strategic, political, propaganda—are much more important. (TCO)

36042 VOLUME DOSE AND GONAD DOSE IN X-RAY DIAGNOSIS. C-E. Unnerus, A. Rekonen, E. Vauramo, and K. Kiviniitty (Univ. Central Hospital, Helsinki). Ann. Chir. Gynaecol. Fenniae, 52: Suppl. 122, 18p.(1963). (In English)

Dose factors were analyzed in 1584 patients undergoing various diagnostic procedures employing fluoroscopy and roentgenography. Total radiation load of the patient was expressed in terms of volume dose. Thus volume dose can be calculated from the dose distribution by multiplying the part of space between 2 successive isodose surfaces by the dose that corresponds to the interval and adding these products. When the voltage range is narrow and the changes in focal distance small, the volume dose is directly proportional to the product D_0A and can thus be regarded as the relative expression of the volume dose: $\Sigma_{rel} = D_0A$. Σ_{rel} can be measured directly by using a plate-like ionization chamber fixed to the x-ray apparatus. Since anatomical differences affect absorption when taken against phantom measurements, and it is difficult to simulate these structures in a phantom, an attempt was made wherever feasible to obtain direct measurements in patients. The mean volume dose values, obtained by the meter attached to the x-ray apparatus operated at 90 kv, varied from 6 millijoule for thoracic to 1013 for colon radiography. Comparative doses were estimated for patients undergoing examination by hypothetical radiologists using good and poor techniques, respectively. In chest examinations these doses were estimated to be two and 14 millijoule for radiography and 14 and 1030 millijoule for fluoroscopy. Radiation load, incident energy, and volume dose in relation to the gonad dose are discussed. The volume dose is of value as a means of checking the methodology of examination to reduce the total radiation load upon the patient with its possible somatic effects. By keeping a check on the volume dose in various circumstances and when using different methods it is possible to establish conditions for improved examination techniques and so reduce the radiation load on the individual. It may also be possible directly to achieve, in this way, results which lead to a reduction of the gonad dose. The results are presented of an indirect but rapid method of calculating the gonad dose from the volume dose, which is possible in certain cases. Suggestions are offered for improved roentgen apparatus and examination methods. (BBB)

36043 RADIATION CONTROL ABOARD THE USS ENTERPRISE CVA(N)65. Lewis H. Seaton. Arch. Environ. Health, 7: 320-4(Sept. 1963).

The radiation control program aboard Enterprise is based principally on three factors: the adequate training of all personnel in good radiation control practices; careful application of time-proved procedures and strict adherence to the regulations concerning radioactive materials; design and establishment of the billet of Radiation Control Officer with the responsibility of coordinating and controlling all phases of the radiation control program. To date the program has been entirely successful, and because of the firm foundation on which it is based, there is reason to believe that it will continue to be so in the future. (auth)

36044 FILMBADGE MONITORING FOR INDUSTRIAL RADIOGRAPHY. H. R. Isenburger (St. John X-Ray Lab., Califon, N. J.). Brit. J. Non-Destructive Testing, 5: 59-68(June 1963).

A review is presented on the development, operation, and performance of the film badge for personnel monitoring. (P.C.H.)

36045 CONTRIBUTION TO THE STUDY OF THE SELF-ABSORPTION OF CARBON-14 β RADIATIONS. Pierre Lerch and A. Vogel-Luedin (Université and Hôpital Cantonal Universitaire, Lausanne, Switzerland). Bull. Soc. Vaudoise Sci. Nat., 68: 69-80(1962). (In French)

For β emitters such as C^{14}, S^{35}, and H^3 in biologic materials of appreciable thickness, it is necessary to correct radiation measurements for self-absorption in the source. It is shown that by proper selection of source-to-counter distance and of the supporting material, an exponential self-absorption correction curve can be obtained. This relation was investigated experimentally for C^{14}(as $BaCO_3$), using supports of aluminum and organic materials and with thin-window and windowless Geiger-Müller counters. The results showed that the self-absorption of C^{14} closely follows an exponential expression. (H.H.D.)

36046 RADIATION EXPOSURE OF ANESTHETISTS. W. D. Kyle (University Hospital, Edmonton, Alberta, Can.). Can. Anaesthetists' Soc. J., 9: 161-4(Mar. 1962).

Efforts were made to measure the radiation doses absorbed by all members of the Department of Anesthesia in a large teaching hospital over a period of months, for the purpose of assessing whether or not dangerous levels of radiation exposure were being reached. The photographic film blackening method was used to measure the dose. Each member of the Department wore a standard badge affixed to the anterior chest area of his operating room clothing at all times. No attempt was made to avoid exposure, with the anesthetist staying in his customary position at all times. Each anesthetist recorded the data and type of procedure when x ray or radioactive material was used in conjunction with anesthesia over a period of 5 months. A total of 195 exposures were recorded, amounting to 6% of the total number of anesthetics administered in this period, exclusive of maternity cases. Only two badges were recorded as having exposure of over 40 mrad in any 2-week period; these were only 50-mrad readings. This was well within the allowable level as stated by the International Commission on Radiological Protection (0.3 rad weekly). The chief radiologist of the hospital concluded that these exposures were not considered sufficient to warrant either continuation of the wearing of the badges routinely, or to suggest any changes in the precautions taken by the anesthetists. If the method of measurement was fairly accurate, and the relative use of x rays in conjunction with anesthesia in this hospital accepted as typical, then it can be assumed that anesthetists have no cause for alarm, and need take no special precautions at present, since the observed doses are well within present-day permissible levels. (BBB)

36047 HOW TO COPE WITH RADIOACTIVE CONTAMINATION IN WATER SUPPLIES. K. Shikaze and D. Caplice. Can. Munic. Utilities, 100: 16-19; 21; 54 (1962).

The degree of pollution is determined by the maximum permissible concentration of the isotopes involved. Conventional methods of water treatment can often be used but facilities will then be required for the disposal of the concentrated radioactive waste. Coagulation with alum or iron salts removes isotopes with a valency of 3, 4, or 5, filtra-

tion removes colloidal material, and softening with lime and ash removes strontium. Ion exchange, phosphate coagulation, electrodialysis, and slurries of metallic dust and clay are also effective methods of treatment; distillation could be used in an emergency. (TCO)

36048 THE PROBLEM OF HEALTH PROTECTION. P. Recht. Diritto Econ. Nucl., No. 1, 23-31(1962). (EUR 172.f). (In French)

Activities of EURATOM concerning health protection are discussed. Three essential points of the policy are: a guarantee before the commencement of nuclear activity; strict monitoring of variations in radioactivity on working sites; scrupulous health surveillance of workers. (P.C.H.)

36049 THE RADIATION EXPOSURE OF ANESTHETISTS AND THE PROTECTIVE PRECAUTIONS IN CLINICS WITH CENTRALIZED THERAPY WITH RADIOACTIVE MATERIALS. Sylvia Kornhas, Guenther Freischuetz, and Elfriede Tochtermann (Universitäts-Frauenklinik, Munich). Geburtsh. Frauenheilk., 23: 509-17(June 1963). (In German)

The radiation dose received by anesthetists during intrauterine implantation of Ra was estimated. With the usual technique employed in this clinic, involving exposure to 70 mg Ra for 15 min, the dose was estimated to be 6.62 mr/hr. On the basis of a 4-hr work day and 5-day week, this would result in an annual exposure of 6.35 r. This exceeds the recommended min permissible dose by about 20%, even though numerous precautions were taken to lower the dose. The anesthetist was usually 1-2 m from the source of radiation. An improved design of the operating room for this procedure and of a recovery room for patients bearing Ra implants is described. Adequate shielding for patients and operators is provided by the new designs. It is also proposed that operating teams involved in this procedure be rotated frequently to minimize the dose to individual personnel and that a central station be set up for supervising all patients bearing radioisotopes. (BBB)

36050 ADDENDUM I TO NATIONAL BUREAU OF STANDARDS HANDBOOK 69. MAXIMUM PERMISSIBLE BODY BURDENS AND MAXIMUM PERMISSIBLE CONCENTRATIONS OF RADIONUCLIDES IN AIR AND IN WATER FOR OCCUPATIONAL EXPOSURE. Health Phys., 9: 565-8(June 1963).

Revised values are presented for maximum permissible body burdens of radionuclides and maximum permissible concentrations of radionuclides in air and water for occupational exposure. The values are taken from an addendum to National Bureau of Standards Handbook 69. (C.H.)

36051 RADIONUCLIDES IN FOODS. Health Phys., 9: 569-96(June 1963).

The contamination of foods by radiation from naturally occurring sources, peacetime applications of atomic energy, or the testing of nuclear devices is reviewed. Organizations engaged in studies on the radioactive contamination of foods are listed. Data on environmental contamination due to fallout from nuclear weapons testing, the concentration of fission products in various foods, and the contribution of various foods to the radioactivity of the diet in various sections of the U. S. are reviewed through 1962. (97 references.) (C.H.)

36052 PRINCIPLE AND APPLICATIONS OF EQUIVALENT DOSE EXPRESSION IN PERSONNEL MONITORING PHOTOGRAPHIC DOSIMETRY. I. Miyanaga and H. Yamamoto. Health Phys., 9: 677-86(July 1963).

The principle and application of equivalent dose relationship in photographic dosimetry are discussed in detail. In spite of the nonlinear relationship between the density of the film and the exposure, differential measurements of mixed radiations are easily determined. When equivalent dose is plotted against exposure for various radiations, the deviation from linearity is less than ±10% up to the maximum reliable reading range of a conventional densitometer. This extends the range of dose to be measured approximately 1.5–2.0 times greater than when compared to the case of limited usage of linear density vs exposure region. Based on this relationship, a routine procedure of analysis for the estimation of the dose is given for mixed radiations including gamma, beta and thermal neutrons. Standard calibrations were made using a Sr^{90}–Y^{90} source rather than radium or Co^{60}. The variation of the density was less than ±3% over the whole range of interest. (auth)

36053 ACCIDENTAL PERSONNEL EXPOSURE TO ELEMENTAL S^{35}. A. R. Maass, T. L. Flanagan, D. Blackburn, and M. Smyth (Smith Kline and French Labs., Philadelphia). Health Phys., 9: 731-40(July 1963).

While an organic chemist was attempting to open a glass ampule containing 1.27 C of elemental S^{35} dissolved in 15 ml of benzene, the vial exploded, and the operator was contaminated internally and externally with the radioactive material. Utilizing the techniques of dilution of the absorbed radioactive material with non-radioactive sulfur in several of its many utilized forms, as well as the administration of agents that seem likely to increase the rate of excretion of S^{35}, the major load of detectable S^{35} was cleared from the body within 5 days. The biological half life of plasma radioactivity was about 19 hr. Approximately 85% of the urinary and 90% of the fecal radioactivity were excreted within 24 hr of the accident. This is in agreement with the classical concept that only a small portion of sulfur introduced in a non-organic form is retained by the body. Observations in this unusual case are discussed in the light of available literature on S^{35}. The body burden was estimated to have been 13–26 μC. There is ample evidence to suggest that these quantities of radioactive sulfur are unlikely to cause any radiation damage and, indeed, no adverse effects have been noted during the 3 years since exposure. (P.C.H.)

36054 ACCURACY AND SENSITIVITY OF FILM MEASUREMENTS OF GAMMA RADIATION. PART III. EFFECTS OF HUMIDITY AND TEMPERATURE DURING GAMMA IRRADIATION. Ronald L. Kathren and Allen Brodsky (Univ. of Pittsburgh). Health Phys., 9: 769-77 (July 1963).

Measurements have been made on several personnel monitoring films to determine the effects of environmental temperatures and humidities on film sensitivity during gamma irradiations of 1–4 hr duration. Films were equilibrated in the environments for periods ranging rom 1 hr to 1 week before irradiation, and were developed at intervals ranging from $^1/_2$ hr to 1 week following termination of irradiation and removal from the environment. Sharp decreases in gamma sensitivity to as low as 50% were found in all experiments at 27°C (80°F) as relative humidity increased above about 60–70%. Increasing temperatures up to 49°C (120°F) produced compensating increases in sensitivity except at zero relative humidity, where sensitivity was independent of temperature in the 27–49°C range. For certain films and exposure conditions a definite reduction below optimum sensitivity was also noted for exposures at very low humidities. Both duPont and Kodak films required about 72 hr equilibration under high humidity conditions to reach equilibrium moisture content; relative sensitivities during irradiation were independent of

equilibration time for longer equilibrations. The results indicate that humidity protection may be desirable even for film packets used only for short wearing intervals. Chemical mechanisms are postulated as plausible explanations for these phenomena. (auth)

36055 X-RAY MICROANALYSIS OF HIGHLY RADIOACTIVE FALL-OUT PARTICLES. T. Mamuro and A. Fujita (Radiation Center of Osaka Prefecture). Health Phys., 9: 779-84(July 1963).

X-ray microanalysis was carried out to determine the main metallic elements in a highly radioactive particle and to investigate the relation between the color of a particle and its chemical composition. Weight percent values obtained for a particle were: Fe, 27%; Al, 17%; and Si, 1.0%. The spectra of the colorless, golden, reddish brown, and black particles showed that the denser the color of a particle, the larger the composition ratio of Fe to Al. (P.C.H.)

36056 AN AUTOMATIC SCANNING AND PRINTING ANALOG-TO-DIGITAL DENSITOMETER. H. F. Gatzek, E. Gordy, and P. Hasenpusch (Roswell Park Memorial Inst., Buffalo). IRE (Inst. Radio Engrs.), Trans. Bio-Med. Electron., 9: 81-4(Apr. 1962).

An instrument for calculating dose distribution in supervoltage radiotherapy is described and illustrated. The instrument automatically extracts the pertinent dose information of closely spaced density measurements on film. These measurements are translated into discrete dose levels in 10% increments which are digitally printed by means of an electric typewriter. The typewriter provides the mechanical scanning of the film, as well as the digital printout. For use with film densitometry, body phantoms representing the patient were constructed. This was done by making radiographic cross sections with a transverse laminagraph at 1-in. intervals. After reducing the films to 1:1 scale with a camera lucida, they were cut out of tissue-equivalent wax plates and put in register. The phantom thus obtained represents the patient and body fluids which might alter the position of the tumor and affect the uniformity of dose distribution. To measure the dose distribution occurring under different conditions, film densitometry was chosen as the most suitable method, but this procedure will be superseded in the future by density measurement in plastic sheets. Films sandwiched between 2 adjacent cross-sections of the phantom were exposed to supervoltage radiation and the resulting blackening of the emulsion, which is related to the delivered dose, has been measured and plotted with the instrument described above. This instrument eliminates the manual work of measuring and plotting densities of the films and enables rapid and automatic estimation of dose distribution in the phantom at several levels. It provides a quantized analog presentation (the typographic pattern forming the isodose contours) as well as a point-by-point digital presentation. Superposition of an anatomical overlay permits direct read-off of radiation dose to any organ present in the cross-section being studied. The instrument, because of its simple, accurate, automatic, rapid operation makes film dosimetry for supervoltage therapy practical on a clinical application basis. (BBB)

36057 RADIATION PROTECTION FOR THE PODIATRIST AND PATIENT. Arthur E. Helfand (St Luke's and Children's Medical Center, Philadelphia). J. Am. Podiat. Assoc., 53: 119-22(Feb. 1963).

Radiation hazards and injuries resulting from radiotherapy and radiodiagnosis applied to the feet are discussed. Overexposure may be a result of accidents, extensive fluoroscopic procedures, and very extensive or repeated radiographic procedures. The most common changes evident to the podiatrist are in the skin, including local erythema, epilation, radiodermatitis, and ulcerations. The later changes which may be presented to the podiatrist are cancer and aseptic bone necrosis. Of greatest concern to the podiatrist are small amounts of radiation to small portions of the body. The x-ray apparatus should be checked for optimum kilovoltage and stray radiation and leakage of the housing, diaphragm, and cone margins. Only modern, well-shielded units should be used, with the knowledge that stationary units designed for podiatric use provide the greatest measure of safety. All podiatry units should have a filter of at least 2 mm of aluminum under the cone. This will remove radiation which does not contribute to the image formation. The filter also contributes to the final x-ray dose and any increase in exposure due to the filter should be determined by the person testing the unit. Utilizing a high kilovoltage and keeping the tube a minimum of 18 in. from the patient will provide an additional measure of safety. A cone, specifically designed for the podiatry unit, should be used at all times to keep the scattered radiation to a minimum and produce a good image. Utilizing the best film, exposure, and processing techniques will provide an additional safety factor. The finest detail in image, for podiatric use, is obtained with the nonscreen film in cardboard holders, which makes possible reduction in dose. Proper position of the film and patient, the longest practical target to film distance, and the optimum exposure factors for these conditions, will add additional safety factors. Attention to points of film development will give the best quality films and reduce the need for re-examinations with their attendant additional radiation exposure. The operator should never hold the film, pointer cone, or tubehead during the x-ray exposure, and the timer control cord should be long enough to permit the operator to stand behind a protective barrier. (BBB)

36058 MASS CASUALTIES: SURVIVAL IN THE EVENT OF AN ALL-OUT THERMONUCLEAR ATTACK. Edward L. Compere (Northwestern Univ., Chicago). J. Intern. Coll. Surgeons, 38: 93-5(July 1962).

The predicted results of a 5-megaton explosion in an urban area are described, as well as means of preventing and treating casualties in a thermonuclear war. (BBB)

36059 THE ORIGIN AND OPERATION OF THE NEW JERSEY STATE COMMISSION ON RADIATION PROTECTION. B. P. Sonnenblick (Rutgers Univ., Newark, N. J.). J. Newark Beth Israel Hosp., 13: 265-76(Oct. 1962).

The origin, function, responsibilities, actions, and possible future activities of the New Jersey Commission on Radiation Protection are described. The Commission has broad authority to formulate and adopt a code of regulations which it considers necessary to prevent unnecessary radiation, defined in the legislative act as any exposure to varied ionizing radiations which is or can be dangerous or injurious to the health of persons or to the industrial or agricultural potentials of the State. The major achievement of the Commission to date has been the promulgation of the New Jersey Radiation Protection Code, widely distributed to all registrants and to numerous other interested individuals and organizations within and outside of the state. This code regulates the use of sealed and unsealed radioisotope sources and the use of dental and medical x-ray devices within the State. The code provides rules concerning responsibility, monitoring, record keeping, exemptions, reporting of incidents, permissible doses and concentra-

tions, and the other general features, and it contains regulations concerning equipment, shielding and conditions of operation of radiation producing units. A recommendation is being considered that would prevent the employment of children under 18 yr of age in occupations which result in exposure to ionizing radiations. The matter of gonadal shielding for children and younger adults during certain radiological procedures has been discussed by the Commission. Other subjects which are likely to be considered for regulation by the Commission are reactor safety in nonfederal establishments and isotope safety in humans. Transfer to the State of New Jersey of certain of the present regulatory controls of the U. S. Atomic Energy Commission is presently being considered. Implications of the proposed transfer are discussed. (TCO)

36060 REPORT ON PRE-OPERATIONAL ENVIRONMENTAL SURVEY, JULY 1960—JUNE 1961. C. Rho and J. S. Jun. J. Nucl. Sci., 2: 147-51(1962). (In Korean)

An extensive pre-operational environmental radioactivity survey was carried out for a year beginning July 21, 1960. As a result of the survey, it was found that the average level of background radiation was in the order of 10^{-2} milliroentgen per hour. The orders of environmental radioactivities were within the range of 10^{-5} through 10^{-8} microcurie per gram (or cc according to the sample type). The fallout radioactivity, on the whole, has kept its order, about 10^{-5} microcurie per ft^2-10 days during the period. No significant anomaly was found. That is to say, there was no appreciable air contamination associated with artificial radioactivity. (auth)

36061 THE BEHAVIOR OF RADIOACTIVE ISOTOPES IN A SEWER. N. T. Mitchell, K. R. Brendish, and G. E. Eden. J. Proc. Inst. Sewage Purif., 586-91(1962).

Experiences in Great Britain with disposal and behavior of radioactive isotopes in a sewer are discussed. The major use of radionuclides is in the form of sealed sources. The total radioactivity of open sources that may be discharged to the sewer is low, and the hazard is negligible. Nevertheless, the behavior of currently used radioactive materials in the sewer or treatment process was evaluated. Procedures for the experimental study and techniques for evaluation are outlined. Results of the experiment followed a behavior pattern noted in other published works on radioisotopes in rivers and sewage treatment processes. Isotopes such as Na^{24}, P^{32}, S^{35}, and I^{131}, that are normally present in solution in sewage are not appreciably retained, while elements normally absent or present in an insoluble form such as Cr^{51}, Co^{60}, and Au^{198} tend to be retained. The dose effect to sewer workers was calculated and necessary precautions to be taken in regard to specific isotopes are outlined. (Public Health Eng. Abstr., 43: No. 8)

36062 RADIATION REDUCTION FOR CHILDREN. Fred M. Medwedeff and William H. Knox (Vanderbilt Univ., Nashville). J. Tenn. State Dental Assoc., 42: 321-7(Oct. 1962).

A technique for dental radiography is proposed that utilizes the potential for radiation reduction inherent in the difference between the size of the film and the primary beam. The beam size is reduced in this area by an instrument collimating and then aiming the resultant smaller beam to cover the film accurately. This instrument was designed to be used with the long-cone technique and to collimate, aim, shield, and hold the film. The periapical instrument consists of a circular collimator of stainless steel with two handles which may be held for additional stability. The window passes just enough radiation to cover the film, with a $^1/_{16}$ in. border for error in aiming. The area of the standard beam is reduced by 5.6 times at the plane of the film. Attached to the collimator is an arm with a nylon bite block and film holding shield which substantially reduces exit radiation. When a film is engaged on the shield, it is aligned precisely with the collimator window. In addition to collimating the primary beam, the instrument also simplifies the long-cone technique, facilitates aiming the cone, shields, and holds the film. Film clarity is improved by the additional collimation. Primary patient irradiation is reduced 560%, assuming a 2.75-in. beam at the end of a short cone and a children's periapical film (Kodak # 0). This does not include the reduction resulting from the shield. Patient irradiation is reduced 2200% to 5600% when the factor of film speed is multiplied by the factor of the device. It is concluded that children's intraoral roentgenology is safer and more convenient with the instruments described. A questionnaire mailed to Tennessee dentists in the summer of 1961 showed that 32.8% used fast film, 37.2% intermediate speed film, and 14.3% slow film (15.7% not reporting). (BBB)

36063 A STUDY OF CERTAIN RADIOACTIVE ISOTOPES IN SELECTED WASTEWATER TREATMENT PLANTS. T. R. Folsom (Scripps Institution of Oceanography, La Jolla, Calif.), G. J. Mohanrao, J. M. Betz, and W. F. Garber. J. Water Pollution Control Federation, 35: 304-33(Mar. 1963).

Gamma ray assay of sewage sludge taken from Hyperion and 9 other sewage plants throughout the United States has indicated that this is an effective method for the determination of radioactivities above background in sewages, and can also be used for the study of sewage flow monitoring, and treatment and disposal methods. Sensitivity of the assay was increased by dehydration and/or drying the sample. A description is given of the multichannel gamma spectrometer, the sampling program, and the analytical techniques used. Specific attention is given to the determination of Cs^{137}, Co^{60}, Zn^{65}, and I^{131}, as well as those radionuclides of natural source: Ra^{226}, Th^{232}, and K^{40}. It is significant that Cs^{137} and Zn^{65} appeared in easily measurable amounts at all the plants investigated. Cobalt-60 was commonly present at Hyperion, but seldom seen elsewhere. Gamma concentrations in raw sewages are compared with allowable levels in drinking water. The natural background activities due to K, Th, and Ra found in sewage solids were related to those found in ordinary rock. Efforts were also made to establish natural background gamma levels. (Public Health Eng. Abstr., 43: No. 8)

36064 EFFECTS OF C^{14} AND Sr^{90} ON ANAEROBIC DIGESTION. Werner N. Grune (Georgia Inst. of Tech., Atlanta), Chun-fei Chueh, and Charles H. Kaplan. J. Water Pollution Control Federation, 35: 493-531(Apr. 1963).

Investigations on the effects of C^{14} and Sr^{90} and their distribution during anaerobic digestion are reported. The rate of gas production from similarly prepared, seeded mixtures with and without C^{14} was not significantly affected up to 1000 μC/l. Ultimate production of gas, lag-phase period, volatile acids concentration, and reduction of volatile matter were not deleteriously affected by concentration of C^{14} up to 1000 μC/l. Although statistically significant lower CO_2 concentrations were found in most of the digesters containing stable or radioactive acetate, the average concentrations differed by no more than 1 to 3%. In the Sr^{90} studies, it was concluded that no deleterious effects were observed on gas production in the presence of Sr^{90} concentrations from 10 to 500 μC/l. Ultimate gas production values, lag-phase periods, volatile acids concentra-

tions, and reduction of volatile matter were not significantly affected by concentrations of Sr^{90} up to 500 μC/l. Sr^{90} in concentrations from 10 to 500 μC/l exerted no significant effect on sludge gas quality as determined by daily gas chromatographic analyses. From a study of decontamination factors (A_0/A_t) to establish the distribution of Sr^{90} in sludge, it was found that the concentration of radioactivity in the sludge solids is greater at the end of the digestion period than at the beginning. (Public Health Eng. Abstr., 43: No. 8)

36065 DECAY CONTAINER FOR RADIOACTIVE ISOTOPES. (to Dolerit Basalt AG). German Patent 1,115,375. Oct. 19, 1961. Filed Jan. 12, 1960. Kernenergie, 6: 365(July 1963). (In German)

The usual decay containers consist of high alloy steel, such as Cr–Ni steel, in combination with concrete. Such containers are very expensive and have very thick walls to obtain the necessary shielding effect. They are unsuitable, therefore, when isotopes with a very long life must be stored since during long storage periods corrosion phenomena occur because of ion exchange and diffusion. In a container for radioisotopes consisting of a block with a cavity accessable from the outside and a stopper for sealing the cavity, the block and stopper were made of basalt. The basalt block can be prismatic and be provided with a cylindrical cavity lying parallel to the prism axis.

36066 SALVAGE CART FOR RADIOACTIVE MATERIALS. (to Total Kommanditgesellschaft Foerstner and Co.). German Patent 1,104,083. Apr. 6, 1961. Filed Feb. 20, 1959. Kernenergie, 6: 366(July 1963). (In German)

The salvage of lost radioactive materials using salvage carts is described. The cart is improved over previous models in order to permit finding and safe pick-up of the smallest particle. Locating the missing radioactivity and its salvage was done by a device whose construction is described.

36067 HAZARDS OF IONIZING RADIATION. M. Berger and B. Lahneche. Lyon Med., 94: 19-39(July 1, 1962). (In French)

36068 RADIATION EXPOSURE OF THE WHOLE POPULATION. F. D. Sowby (Dept. of National Health and Welfare, Ottawa). Med. Serv. J. Can., 18: 63-7(Feb. 1962).

The present levels of radiation exposure of the Canadian population are evaluated and are discussed in terms of the max permissible doses recommended by the International Commission on Radiological Protection (ICRP). For occupational exposure the max permissible annual genetically significant dose is 33 mrem. This dose would be reached if 0.7% of the whole population accumulated the max permissible occupational gonad dose of 60 rems by age 30. At the present, it is estimated that in Canada about 30,000 persons (or about 0.2% of the total population) are occupationally exposed to radiation. A considerable fraction are over the reproductive age, and the great majority of occupationally exposed persons receive much less than the max permissible individual dose. In 1959 the upper limit for the occupational dose was estimated to be less than 0.5 mrem, or about $\frac{1}{60}$ of the ICRP apportionment. It would therefore seem that there would have to be a considerable increase both in the number of radiation workers, and also in their exposures, before the genetic dose from this source could reach 1.0 rem. For special groups the max permissible annual genetically significant dose is 17 mrem. People living near atomic energy plants are the main contributors to this exposure; the max permissible individual dose for this group is 0.5 rem/yr, and if every individual received this dose, this group should not exceed 3% of the population. The 3rd category, the population at large, is exposed to radiations from atomic energy establishments, radioisotopes and x-rays in industry, medicine and research, and to a large assortment of miscellaneous sources. For all these sources of radiation the max permissible annual genetically significant dose is 67 mrem; this is made up of 50 mrem from internal exposure, and 17 mrem from external exposure. Exposures from fallout were not considered by the ICRP. If they are to be taken into account they should probably be included in the category of exposure of the population at large, which would further use up the allotment of 17 mrem. This analysis was concerned only with genetic dose. It was concluded that there is a possibility that a considerable portion of the allotment for external exposures of the population may soon be used up. This raises the question of whether this particular allotment should be increased, and if so by how much, and which allotment should be correspondingly reduced. (BBB)

36069 NUCLEAR TESTING AND FALLOUT. Frank B. Berry (Deputy Assistant Secretary of Defense, Washington, D. C.). Med. Times, 90: 141-6(Feb. 1962).

After a brief survey of hazards to humans from radioactive fallout and other sources of radiation, it is concluded that the possibility of harmful effects is greatly overestimated. It is suggested that the radiation so far received by humans from fallout is well within safe limits and is less than other sources of radiation. Further, many avoidable sources, such as high altitudes, wristwatches, radioactive coated beads used at night as locators, and television are forgotten as sources by those who emphasize nuclear explosion testing as the prime source. (BBB)

36070 BRITISH STANDARD OF RADIOACTIVE IODINE-131. W. J. Callow (National Physical Lab., Teddington, Middx., Eng.). Nature, 199: 898(Aug. 31, 1963).

Previously, the British Standard of iodine-131 was in terms of the γ dose in air at 1 cm from a 1 mC point source. Recently, certificates giving disintegration rate values both from ionization chamber values and from 4π β-γ coincidence counting have been issued. Henceforth standards will be based on the 4π β-γ coincidence method. (H.M.G.)

36071 THE DISTRIBUTION OF FALLOUT RADIONUCLIDES (Sr^{90}, I^{131}, AND Cs^{137}) IN NATURALLY CONTAMINATED MILK. H. Lagoni, O. Paakkola, and K. H. Peters (Bundesforschungsanstalt für Milchwirtschaft, Kiel). Naturwissenschaften, 50: 495-6(1963). (In German)

The distribution of Sr^{90}, I^{131}, and Cs^{137} in milk was investigated in the autumn of 1962. The concentration of the radioisotopes in 1 kg of the milk used was 44.5 pC Sr^{90}, 176.0 pC Sr^{89}, 106.0 pC I^{131}, and 91.0 pC Cs^{137}. The distribution of the isotopes in the fatty part of the milk and in the non-fatty constituents was determined and the results are tabulated, showing that most of the radioisotopes follow the aqueous phase to the skim milk. 60% of the radioiodine goes to the butter fat. In acid precipitation of the skim milk more than 90% of the Sr^{90} goes with the whey, whereas the I^{131} and Cs^{137} go with the casein. (J.S.R.)

36072 RADIOACTIVITY IN FOODS: IS ACTION NEEDED? C. L. Comar (Cornell Univ., Ithaca, N. Y.). N. Y. State J. Med., 63: 291-4(Jan. 15, 1963).

After a survey of the levels of contamination of food supplies in the United States, as a result of fallout from nuclear weapons tests, it is concluded that no individual or governmental action is necessary at this time to lower the radio-

activity intake of human populations. Doses from fallout up to 1961, calculated on a 70-yr basis, for bone, bone marrow, and reproductive cells are estimated to be $^1/_{10}$ to $^1/_{100}$ of the doses from background radiation. To make a specific comparison of risk levels and attitudes toward such levels, the biologic cost from the use of automobiles is considered. A Federal Radiation Council report concludes that radiation exposures anywhere near the established guides involve risks so slight that counter-measures may have a net adverse rather than favorable effect on the public well-being. (TCO)

36073 DETERMINATION OF STRONTIUM-90 IN SAMPLES OF MILK. M. Zanetti and F. Cutrufelli (Università, Bologna). Nuovi Ann. Igiene Microbiol., 12: 412-15(Sept.-Oct. 1961). (In Italian)

Sr^{90} concentrations were determined in milk samples obtained in 13 cites and towns in the Emilia, Romagna, and Marche Abruzzo districts of Italy during July and August 1961. Sr^{90} was separated by evaporating the milk, ashing the residue, precipitating it as the nitrate, and counting it as the carbonate. The mean value for all samples taken was 6.9 pC/l, which is considerably lower than the levels of 11 to 20 pC/l found in Milan in 1958 and 1959 and the values of 17 and 34 found by the Centro di Studi Nucleari at Ispra in 1959. However, they are higher than the levels recorded in Czechoslovakia in 1957 (3.5), 1958 (6.4), and 1959 (5). It is pointed out that the present milk samples were obtained before resumption of nuclear testing by the U.S.S.R. and U.S.A. in 1961 and 1962. The levels are far below the max permissible limit of 80 pC/l. (BBB)

36074 MODERN THREATS TO HEALTH. I. RADIATION HAZARDS. F. L. Burn (Dept. of Public Health, Salford, Eng.). Nursing Times, 58: 1314-16(Oct. 19, 1962).

Sources of radiation exposure of the general public are discussed as well as the hazards involved and protective measures. (TCO)

36075 STUDY OF THE DOSE FROM Co^{60} IN THE NEIGHBORHOOD OF THE DISTANCE OF THE NET-PLAIN BETWEEN 2 MEDIA WITH DIFFERENT ATOMARY COMBINATION. J. Dutreix, A. Dutreix, and M. Bernard (Institut Gustave Roussy, Villejuif, France). Radiobiol. Radiotherap., 4: 13-23(1963). (In French)

The measurement of the ionization at the interface between carbon and a metal furnishes some hints for the estimation of the absorbed dose in a cone of gamma rays of Co^{60} through a water-equivalent medium adjoining a material of a higher Z. When the water-equivalent medium lies behind the metal, then the dose is less than the dose in the water, with exception of values of Z lying higher than 75. When it is lying in front of the metal, the dose is higher than the dose in water directly in front of the metal, with exception of the values of Z higher than 40. These phenomena may be explained when one distinguishes the different contributions to the stream of electrons. The comparison of the ionization among the different media and the corresponding coefficient of absorption allows one to ascribe to the cone of gamma rays of Co^{60} electrons of an average of 10 Kev, as the electrons representative of the stream of electrons in equilibrium. (auth)

36076 THE OCCUPATIONAL HAZARD FROM IONIZING RADIATIONS AND THE PROTECTION OF THE GENERAL PUBLIC. P. Recht, E. Jacchia, and A. Marchini-Camia. Rev. Belge Securite Sociale, 1-41(1963). (EUR 168.f). (In French)

An outline is given of the reasons why problems relating to compensation for radiation damage sustained in industry are of such importance and urgency. An account is then given of the repercussions of the Basic Standards prescribed by EURATOM on regulations governing compensation for radiation damage sustained in Community industries. There is a detailed description of the various biological effects of ionizing radiations. The dose-effect relationship and delayed radiation effects are successively considered; finally, a number of conclusions are drawn from a somewhat sketchy knowledge of the biological action of radiations. The present state of legislation in Community countries is briefly summarized. The manner in which the compensation regulations in force in these countries can be harmonized and adapted is described in general terms. (auth)

36077 MINOR HEMATOLOGIC AND VASCULAR DISORDERS OF STOMATOLOGISTS: THE HAZARDS OF DENTAL RADIOGRAPHY. A. Fiehrer. Rev. Pathol. Gen. Physiol. Clin., 61: 139-41(1961). (In French)

A case history is cited relating blood changes in a physicial attributable to irradiation received from regularly holding the film during oral radiographic procedures. A clotting disorder was manifested by ecchymosis on the arms and a hematoma on the leg. A slight thrombopenia and low prothrombin activity were detected, but the other clotting factors tested were normal. Anemia, leucopenia, and eosinophilia were present, indicating bone marrow insufficiency. The case illustrates the imprudence of radiologists hand-holding films during dental and other oral x-ray examinations. (BBB)

36078 POSSIBILITIES OF ELIMINATION OF RADIOACTIVITY FROM DRINKING WATER. G. Finger and H. Schulz-Utermohl. Rev. Port. Med. Militar, 7: 215-17(1959). (In Portuguese)

36079 MAN IN THE ATOMIC AGE. Hans R. Schinz (Kantonsspital, Zurich). Schweiz. Med. Wochschr., 92: 435-45(Apr. 14, 1962). (In German)

Hazards of ionizing radiations to human beings are discussed, and precautions to be employed in medical uses of radiation for protection of patients and operators are recommended. (BBB)

36080 MASS CASUALTIES: FIRST AID AND TRANSPORT. Lassi Antila (Univ. Hospital, Tarku, Finland). Sotilaslaaketieteellinen Aikakauslehti, 37: 49-61(1962). (In Finnish)

36081 THE RADIATION HAZARDS FOR POPULATIONS IN NORTHERN COUNTRIES FROM NUCLEAR WEAPONS TESTS ON NOVA ZEMLA AND POSSIBLE PROTECTIVE MEASURES. Svenska Lakartidn., 59: 553-69(1962). (In Swedish)

36082 OBSERVATION OF FALL-OUT IN TOKYO. [PART] I. Hamaji Suzuki, Minoru Tanaka, Kunihiko Asakuno, Nobuo Shibata, Atsushi Nukazawa, and Haruhisa Yoshikawa. Tokyo Metroplitan Isotope Centre Ann. Rept., 1: 104-12(1962). (In Japanese)

Total radioactivities of fallout in rain water and air dust observed in Tokyo are reported. The maximum radioactivities from October to November in 1961 were 125 $\mu\mu$ C/m^3 in dust and 3.0 $\mu\mu$ C/ml in rain water. This may be due to nuclear tests in September, 1961. The observation of gross radioactivities and Sr^{90} concentration in rain water, vegetables, and soil in Miyake-Jima, Tokyo, has been carried on since July, 1960. The results showed no significant differences from the values observed in other places. Total radioactivities in rain water were 0.4 to 1.17 cpm/l in 1960 and 8 to 7476 cpm/l in 1961, and in vegetable 3.4 to 7.9 cpm/dry weight (g) in 1960. The concentrations of Sr^{90} were

16 to 78 $\mu\mu$ C Sr^{90}/Ca (g) in vegetables and 10 to 85 $\mu\mu$ C Sr^{90}/Ca (g) in soil. (auth)

36083 GONADAL DOSIMETRY IN DIAGNOSTIC RADIOLOGY. David L. Moody, John R. Cameron, and John H. Juhl (Univ. of Wisconsin, Madison). Wisconsin Med. J., 61: 115-18(Feb. 1962).

The range of dosages in x-ray examinations at a university hospital was investigated, using a phantom simulating a human figure from the costal margins to the lower thigh above the knees for radiological measurements. Within a full-body cast of an adult female were placed lumbar vertebrae, pelvic skeleton including coccyx, and attached femurs. The cavity was then filled with molten Mix-D (tissue equivalent 1.0) and allowed to harden. After removal of the cast, ovarian location was determined from anthropological tables; then holes 1.5 cm. in dia were drilled from the anterior and lateral aspects of the model intersecting at the desired position for both the left and right ovaries. This was to allow determination of ovarian dosages by insertion of pocket dosimeters at a 90° angle to the x-ray beam. The surface, exit, and gonadal doses are tabulated for various procedures; the mean male and female gonad doses, respectively, were: for anteroposterior examination of lumbar spine 1400, 320 mr; barium enema series 67, 40; gastrointestinal series 3, 65; intravenous pyelogram 150, 76; pelvis 1800, 310; hip 120, —; knee 18, 0; and gall bladder 0, 9. It is apparent that certain examinations provide greater gonadal exposure than others, and this becomes a consideration in these examinations, particularly in younger age groups. As expected, examinations requiring direct exposure of the pelvis result in more gonadal irradiation, but with careful coning and positioning, examinations as close to the pelvis as the knee result in essentially no gonadal dose. The importance of using high-voltage techniques is seen by comparing barium enema (110 kv) dosages with those from the lumbar spine examination (75 kv). In these the focal axis and size of the field are identical, but use of a low-voltage technique necessitates a high ma-sec value to compensate, and this results in a higher radiation dosage. The tabulated results indicate that examinations of the lumbar spine, lumbosacral joint, and pelvis produce considerably more gonadal exposure than any of the other procedures. It is possible to shield the male gonads adequately in these procedures and reduce the exposure to a min; this should be done particularly when patients under the age of 30 yr are examined. Since the female gonads are in the area of interest in many examinations of the lumbar spine and pelvis, local shielding cannot be used. Whenever the central pelvis does not need to be included, local shielding using lead or lead-rubber can be employed. The intravenous pyelogram also results in a considerable male gonadal exposure when local shielding is not used, but it can be diminished considerably by local shielding. In the examination of the lower urinary tract the female gonads are in the direct beam and are therefore exposed to a moderate amount of radiation. However, it is possible to take two of the three necessary excretory films centered over the kidneys with shielding of the lower abdomen. In this way the female gonads are kept out of the direct beam in two of the four exposures used routinely in this examination. (BBB)

36084 CONSIDERATION FROM THE VIEWPOINT OF OCCUPATIONAL MEDICINE OF THE PROBLEM OF LEUKEMIA AND CHEST DIAGNOSIS, WITH REFERENCE TO A CASE OF ALLEGEDLY RADIATION-INDUCED LEUKEMIA. H. Rein (Staatliches Gewerbearztes in Westfalen, Bochum, Ger.). Zentr. Arbeitsmed. Arbeitsschutz, 12: 246-50(Oct. 1962). (In German)

Development of leukemia in a 37-yr-old woman who underwent chest roentgenography 30 times because of pulmonary tuberculosis is described. Leukemia was diagnosed 7 yr after these diagnostic procedures were begun. The patient had also received arsenical drugs, but their possible effect on leukemogenesis could not be evaluated. It is estimated that the total bone-marrow radiation dose received by this patient was 50 to 100 rad, which is within the range of the doses received by irradiated spondylitis patients reported to subsequently develop leukemia. The literature relating to radiation induction of leukemia is reviewed and means of lowering the absorbed dose in chest roentgenography are discussed. It is concluded that voltage increase and Al filtration (90 kv, 6 mm) reduce patient exposure without impairing film contrast or detail. (BBB)

36085 RADIOLOGICAL HEALTH DATA [MONTHLY REPORT], VOLUME IV, NUMBER 8. (Public Health Service, Washington, D. C.). Aug. 1963. 35p. $0.50(GPO). (RHD-Vol. 4, No. 8)

Data are presented on fission product radioactivity in samples of surface air, precipitation, surface waters, water supplies, and milk collected throughout the U. S. and Canada and other selected sites during 1962 and 1963. An analysis was made of the Sr^{90}/Ca ratio in infant and adult diets at New York City, Chicago, and San Francisco between April and November, 1962. Data are included on environmental levels of radioactivity at the Savannah River Plant during 1962. Results are reported from whole-body measurements of Cs^{137} in man made at Landstuhl, Germany. (C.H.)

36086 SOME PROBLEMS OF RADIATION PROTECTION NEAR ACCELERATORS. E. L. Stolyarova and G. A. Cherevatenko. p.111-26 of "Uskoriteli." Moscow, Inzhenerno-Fizicheskiy Institut, 1962.

A general review of shielding requirements is followed by a discussion of the specific case of accelerators producing electrons with energies up to 100 Mev. Shielding from the gamma-ray bremsstrahlung is considered. Calculations show that concrete shields up to 200 cm thick are required at 3.5 m from the target subjected to a 100 Mev beam; for photoneutrons shielding only theoretical formulas are given. Shielding of American proton synchrocyclotrons (up to 400 Mev) by means of concrete or composite blocks is also described. (OTS)

36087 ON THE DETERMINATION OF THE DEPOSITION VELOCITY OF RADIOACTIVE DEBRIS AT ISPRA. M. de Bortoli, P. Gaglione, A. Malvicini, and E. Van Der Stricht (Euratom, Ispra, Italy). 16p. (CONF-141-1; EUR 364.i). (In Italian)

From Congress of the Associazione Italiana di Fisica Sanitaria, Turin, Feb. 1963.

The measurements of the deposition velocity of radioactive debris performed weekly at Ispra during the period June–September 1962 are described. The data obtained were used to evaluate the extent of dry fallout. (auth)

36088 LIQUID SCINTILLATOR TRITIUM DETERMINATION IN THE URINES OF STAFF MEMBERS OF A NUCLEAR CENTER. V. Camera and M. Giubileo (Euratom, Ispra, Italy). 16p. (CONF-142-1; EUR 333.i) (In Italian)

From 25th National Congress on Labor Medicine, Taormina, Italy, Oct. 1962.

The concentration of tritium was measured for 9 months in the urine of 96 persons who worked around a reactor that is moderated and cooled by heavy water. A total of 683 de-

terminations were done by counting the beta impulses in a liquid scintillation counter. The apparatus and phototubes in coincidence were refrigerated and had an efficiency of 8%. In 50% of the samples examined the concentration of tritium was inferior to the reading threshold (0.1 microcurie/liter). The highest level seen was 1.6 microcurie/liter, which corresponds to 5% of the C.M.A. In 2 cases of internal contamination it was possible to verify the biological half life of tritium, which is 10–12 days. (auth)

36089 THE CONCENTRATION OF URANIUM IN THE URINE OF THE STAFF OF A NUCLEAR POWER PLANT. V. Camera and M. Giubileo (Euratom, Ispra, Italy). 25p. (CONF-142-2; EUR 334.i). (In Italian)

From 25th National Congress on Labor Medicine, Taormina, Italy, Oct. 1962.

The concentration of natural uranium in the urine of 78 workers from the groups of industrial chemistry and metallurgy of uranium, was followed for 3 years. A total of 1471 analyses were done with the fluorimetric method. Urine checks were made every week, or every 15 days or more according to the amount of exposure, which was evaluated by investigations done at the place of work and on the basis of information collected from the workers during the periodical medical examinations. The majority (74%) of the analyses of personnel least exposed revealed levels equal to or inferior to 1 gamma/liter, whereas (66%) the group with an intermediate risk showed 1 to 5 gamma/liter, and in the group most exposed levels of 5-10 gamma/liter were found in 37% of the cases; from 10-20 gamma/liter in 19%; and from 20-50 gamma/liter in 7% of the cases. Only 1% of the samples had a level superior to 50 gamma/liter. An attempt to establish a correlation between the level of uranium found in the air and in the urine gave no tenable indication concerning the real work risk, due to the variability of atmospheric contamination with time and the incessant movement of almost all the workers from one laboratory to another during the day.

36090 RADIOLOGICAL INHALATION SAFETY CODE (RISC). G. H. Anno, P. J. DuBois, T. P. Wilcox, and J. K. Witthaus (Aerojet-General Nucleonics, San Ramon, Calif.). 32p. (CONF-39-90; AGN-TP-44)

From American Nuclear Society 9th Annual Meeting, Salt Lake City, June 1963.

RISC is a digital machine program used to compute internal exposures to seven body organs or tissues (thyroid, bone, muscle, lungs, gastro-intestinal tract, soft body tissues, and testes) incurred over the first year period following short-duration inhalation. Doses to the body organs are based on computations of up to 50 radionuclide sources. Basically, three different atmospheric source release models are built into the program in order to simulate the release of material from: a stationary source; a source moving vertically upward, such as a launched rocket; and a source that moves horizontally, parallel to the horizon. A basic diffusion theory is used in the development of specific atmospheric diffusion models. The effects of a capping temperature inversion may be estimated, along with washout and dry fallout. (auth)

INDUSTRIAL APPLICATIONS OF ISOTOPES AND RADIATIONS

36091 (BNL-804) A CHEMONUCLEAR PROGRAM FOR THE USAEC. B. Manowitz, C. Raseman, M. Steinberg, S. Stoller, J. Hogerton, and L. Geller (Brookhaven National Lab., Upton, N. Y.). July 1963. Contract AT-30-2-GEN-16. 95p. (BNL-T-309)

The current status of work in the United States on the applications of nuclear energy to the direct production of chemicals through the utilization of the kinetic energy of recoiling fission fragments in chemonuclear reactors was reviewed. Basic and applied research has been carried out on chemonuclear systems over the past several years by a small number of AEC, university, and industrial organizations. In recent years interest has been evidenced by a large segment of the chemical and petrochemical industry in the potentialities of the direct use of fission fragment energy for large-scale chemical production. The technical data now available do not permit accurate chemonuclear production cost estimates. Such rough estimates as have been made do not appear to warrant embarking at this time on a full-fledged product-oriented large-scale program. Instead, circumstances appear to dictate an orderly sequence of basic and applied research and exploratory development work. This effort should be concentrated on (1) studying the fundamental radiation chemistry effects peculiar to fission fragments, (2) determining yields, conversions, reaction mechanisms, and kinetics for various systems that appear promising, and (3) developing necessary general technology, unique to the chemonuclear field, primarily through the construction and operation of in-pile loops. While a large-scale reactor experiment does not appear justified at this time, the work in this field should be reviewed periodically to determine the direction in which the long-range program should go. (auth)

36092 (BNL-808) SHIPBOARD COBALT-60 RADIO-PASTEURIZER. STUDY REPORT FOR MARINE PRODUCTS. (Vitro Engineering Co., New York). June 30, 1963. For Brookhaven National Lab., Upton, N. Y. Contract AT (30-2)-Gen-16. 72p. (BNL-T-311)

Results of a study to conceive, evaluate, review, and estimate costs for a number of suitable designs for a Co^{60} Shipboard Fish Irradiator; select a preferred type; and establish required criteria for future detail design and construction of the selected concept are reported. Three irradiator concepts are described. Four schemes for handling fish aboard ship, exclusive of the irradiator are also described. A single concept, designated as the movable source slab concept, is selected as most promising because of its relatively low initial cost, compatibility with the ship design, relatively light weight, good efficiency, good maintenance characteristics, good reliability, and good compatibility with diverse schemes for handling the fish aboard ship. The shipboard irradiator is designed to extend the storage life and preserve the fresh flavor of fish by subjecting the fish to a partial dose of 75,000 to 150,000 rads aboard ship, followed by further processing irradiation on a land-based irradiator. (auth)

36093 (JPRS-20805) THE APPLICATION OF RADIOISOTOPES IN METALLURGY. R. Vojinovic. Translated from p.12 of "Privredni Pregled", Belgrade, May 25, 1963. 3p. (OTS-63-31622)

A brief survey is made of the metallurgical applications of radioisotopes in Yugoslavia. Both facilities and accomplishments are described, and possible future applications are considered. (D.L.C.)

36094 SOME APPLICATIONS OF RADIOISOTOPES IN THE CHEMICAL INDUSTRY. P. Johnson, R. M. Bullock, and J. Whiston (Imperial Chemical Industries, Ltd., Billingham, Eng.). Chem. Ind. (London), No. 19, 750-6(May 11, 1963).

Illustrative examples are cited from the work of a Radioisotopes Applications Group which has been operating for several years in a large industrial complex comprising a wide variety of chemical plants and processes. The discussion is concerned mainly with the application of radioisotopes to chemical process problems. It is pointed out that investigation of various forms of malfunction in a plant is also greatly assisted by radioisotopes. Various arrangements of sources and detectors for the measurement and control of radioactivity levels in liquids are shown diagrammatically, and an arrangement showing how γ-ray back-scatter may be applied to the location of levels is illustrated. A procedure for the detection of liquid levels by absorption, which was developed into a routine method for the study of malfunction in distillation columns, is described. The sensitivity with which minute amounts of radioactive tracers can be detected makes them extremely valuable in the location and measurement of liquid and gaseous leaks. An example of their application is cited in distillation processes where it is often necessary to satisfy exacting specification for the water content of refined product. Safety considerations in the industrial use of radioisotopes are considered. (TCO)

36095 THE APPLICATION OF RADIOISOTOPES TO RAILWAY SIGNAL SYSTEM. Shinichi Sakai (Tokyo Electrical Railway Express). Denki Zasshi OHM, 49: No. 5, 75-8(May 1962). (In Japanese)

A γ-ray source of 1-mC Co^{60} sealed in a pig iron container was installed under a car. The detector used was a G-M counter in a brass case and buried underground between two rails. When a train passes, the detector triggers the relay circuit, which sends out the signals. Two types of G-M counters, type-8165 (25 mm × 280 mm) and type-8168 (50 mm × 330 mm), were used. Type 8168 was 5 times more sensitive than type-8165 and gave good results for source-detector distance between 20 ~ 30 cm and speed 25 ~ 82 km/hr. Type 8165 succeeded at 20 cm and 25 ~ 55 km/hr, but failed at 30 cm and 76 ~ 82 km/hr. It was concluded that 20 cm is the proper distance between the source and detector. The device surpasses the conventional contact type signal system in its simplicity, lower cost, applicability to distinguish train type or determine train speed, and is undisturbed by bad circumstances such as snow and gravel due to γ-ray penetrating power. (OID)

36096 INACTIVATION-RATE STUDIES ON A RADIATION-RESISTANT SPOILAGE MICROORGANISM. III. THERMAL INACTIVATION RATES IN BEEF. D. E. Duggan (Univ. of Kansas School of Medicine, Kansas City), A. W. Anderson, and P. R. Elliker. J. Food Sci., 28: 130-4(Mar.-Apr. 1963).

Micrococcus radiodurans, a nonsporing spoilage bacterium highly resistant to ionizing radiation and to ultraviolet light, can be isolated from spoiled meats that had been irradiated to 2 or 3 megarep. The extreme resistance to radiation of this microorganism makes commercial sterility by irradiation difficult to obtain without adverse effects on flavor. Survival curves for cultures of this organism exhibiting the highest radiation resistance were determined at several temperatures in a beef substrate, and a thermal resistance curve was constructed. A modified thermal-death-time tube was used, with cells uniformly suspended in a raw meat puree reconstituted from freeze-dried and powdered beef that had been screened to remove pipette-plugging fibers and irradiated to eliminate viable organisms before use. Thermal death rate, unlike the radiation death rate, approximated an exponential form, as indicated by survival curves. Heat treatment reduced the resistance of this organism to subsequent irradiation, and it was also shown that irradiation at higher temperatures (40 and 50°C) is more effective in inactivating this organism than irradiation at temperatures below 40°C. It may be of some advantage, then, to use radiation and heat treatment concomitantly in attempting to limit spoilage due to this organism. (TCO)

36097 STORAGE OF SWEET POTATO TUBER BY X-RAY IRRADIATION INFLUENCE OF X-RAY IRRADIATION ON THE CORK LAYER FORMATION OF THE WOUNDED CORTEX. C. H. Kang, Y. C. Park, and C. I. Park (Chun-Nam Univ., [Korea]). J. Nucl. Sci., 2: 122-5 (1962). (In Korean)

Experiments were made on the influence of the cork layer formation along sharp knife wounds on the cortex of the sweet potato tuber. The dosages of x irradiation were divided into 750, 1500, 3000, and 6000 r, and the irradiated sweet potato was stored at either 13–16°C or 18–20°C. X irradiation hastened the cork layer formation on the wounded cortex of the sweet potato, especially 3900 r. X irradiation at 3000 r hastened the cork layer formation under both conditions compared with the control. X irradiation of 6000 r influenced the formation of the cork layer as strong as that of 3000 r, but it made the layer scattered and rough in the latter period. According to the results, it was concluded that x irradiation of about 3000 r is able to hasten the cork layer formation on the wounded cortex in the sweet potato. (P.C.H.)

36098 SPROUT INHIBITION OF ONION BULBS BY γ-RAYS. Gisuke Meshitsuka, Shozo Iba, Mitsuru Ika, Hisao Matsubara, Masae Tabei, Kunio Yamazaki, Yukio Inokoshi, and Seizaburo Kaneko. Tokyo Metropolitan Isotope Centre Ann. Rept., 1: 78-81(1962). (In Japanese)

A large quantity of onion bulbs packaged in commercial-type packaging was irradiated at dosages of 1, 3, 5, and 6 kr by Co^{60} γ rays. Storage tests were performed under three different conditions: 0-2, 13°C, and room temperature. Irradiation of 3 kr or more reduced the sprouting rate of packaged onion bulbs. However, the sprouting rate of the packaged onion was higher than that of the unpackaged, which may be due to the high relative humidity in the package. On the effect of temperature, onions stored at 13°C showed a higher rate of sprouting than those at room temperature storage. It was concluded that the sensitivity depends to some extent on variety, habitat, cultivation, stage, and size of onion bulbs. (P.C.H.)

36099 PRESERVATION OF STRAWBERRIES BY Co^{60} GAMMA-RADIATION. Gisuke Meshitsuka, Mitsuru Oka, Kunio Yamazaki, Hisao Matsubara, and Masae Tabei. Tokyo Metropolitan Isotope Centre Ann. Rept., 1: 82-5 (1962). (In Japanese)

Strawberries packed in shallow wooden cases were sealed in polyethylene bags and irradiated at room temperature by Co^{60} gamma rays at dosages of 0, 5, 10, 20 and 40×10^4 r. Preservation tests were performed at 4°C for 45 days after irradiation. The deterioration of qualities by irradiation was not too serious and even at the high dosage up to 40×10^4 r, only a little decoloration of the fruit juice and slight softening of the texture was observed. A low dosage of 5×10^4 r was fairly effective in retarding the appearance of visible fungus growth. The polyethylene seal seemed to prevent a microbial post-infection. Possibilities of radiopreservation of strawberries at a comparatively low level dose are also discussed. (P.C.H.)

36100 METHODS OF DETERMINING THE VAPOR PRESSURE OF METALS AND THEIR COMPOUNDS USING RADIOISOTOPES. S. P. Detkov. Tr. Ural'sk. Elektromekhan. Inst. Inzh. Zheleznodorozhn. Transporta, No. 2, 101-23(1959).

A survey was made of the basic methods for determining the vapor pressure of metals and their compounds. The integral and differential effusion methods, as well as the method of exposed surface evaporation, static and dynamic methods, and the isotopic exchange method were examined in more detail. Some details of methods using radioisotopes are also mentioned. (TCO)

36101 BETA RADIATION PROCESSING IN COAL CONVERSION. Paul M. Yavorsky (Consolidation Coal Co., Library, Penna.). 5p. (CONF-124-3)

From Symposium on the Application of Advanced Technology to Coal Research, Lexington, Ky., June 1963.

The conversion of coal to gasoline and other oil products by solvent extraction of coal to obtain a meltable organic fraction and the hydrogenation of this extract are discussed. Studies were made to see if radiation would promote hydrogenation and serve as replacement for contact catalysts. The concept of using an intense beta source inside a high-temperature, high-pressure heavy steel reactor was developed. About 20 radiation-processing runs on hydrogenation of coal extract were completed at hydrogen pressures up to 5000 psi, and temperatures up to 430°C. No significant radioinduced hydrogenation of coal extract, beyond that obtained by ordinary thermal reactions was found. The hydrogen content of the gross products was no greater than for comparative runs with no radiation and no contact catalyst. (M.C.G.)

36102 NEW IRRADIATION RESEARCH FACILITIES AT THE ARMY NATICK LABORATORIES. R. D. Cooper and A. Brynjolfsson (Army Radiation Lab., Natick, Mass.). 5p. (CONF-35-3)

From American Physical Society Meeting, Cambridge, Mass., Mar. 1963.

New facilities built by the U. S. Army for research on the preservation of food by ionizing radiation consist of a food processing and packaging facility and a radiation sources laboratory with two powerful low-energy radiation sources. One is a 1.3 million-curie Co^{60} source consisting of 98 tubes each containing four doubly encapsulated Co^{60} slugs. The second source is an electron linear accelerator with energy variable between 2 and 32 Mev. Research with the Co^{60} source is concentrated on investigation of macroscopic and microscopic dose distribution in different materials irradiated with Co^{60} γ rays. Research with the linear accelerator is concentrated on dosimetry and photonuclear reactions. (A.G.W.)

36103 INTERNATIONAL EXPERIENCE IN THE USE OF RADIOISOTOPES. V. Zeleny (International Atomic Energy Agency, Vienna). 12p. (CONF-9-21)

From Canadian Nuclear Association, International Conference and Future Development of Power Reactors and on Radioisotopes, Montreal, May 1963.

Applications of radioisotopes in agriculture, medicine, and industry on an international basis are discussed. Programs described include: isotope techniques in rice cultivation, the use of radiation for control of harmful inset populations, radiation disinfestation of grain, preparation of Ca^{147}, the calibration and standardization of thyroid radioiodine uptake measurements, and publication of description of industrial applications of radioisotopes. (M.C.G.)

36104 TRAINING FOR WORK WITH RADIOISOTOPES. D. R. Wiles (Carleton Univ., Ottawa). 8p. (CONF-9-20)

From Canadian Nuclear Association, International Conference and Future Development of Power Reactors and on Radioisotopes, Montreal, May 1963.

The role of the universities in training scientists and technicians in the use of radioisotopes is reviewed. (M.C.G.)

INSTRUMENTS AND INSTRUMENTATION

General and Miscellaneous

Refer also to abstracts 36419, 36439, and 36440.

36105 (AAEC/TM-204) A DIFFERENTIAL TRANSFORMER MEASURING APPARATUS. H. J. Fraser (Australia. Atomic Energy Commission Research Establishment, Lucas Heights, New South Wales). July 1963. 18p.

The equipment described was designed for static displacement measurements with linear differential transformer transducers in applications requiring high sensitivity and low drift. The output from the circuit is displayed on a potentiometric recorder and an a-c backoff arrangement allows the same basic sensitivity up to 20 times full scale deflection. Weekly drift of the output is less than 0.1 mv which is equivalent to an input drift of 0.005 mv. For longer term measurements any drift due to valve aging etc. can be corrected by inbuilt self-checking facilities. (auth)

36106 (AD-286924) AN INVESTIGATION OF THE APPLICATION OF THE MÖSSBAUER EFFECT TO ACCELEROMETERS USED FOR INERTIAL NAVIGATION (thesis). Jack E. Hesse, Jr. (Air Force Inst. of Tech., Wright-Patterson AFB, Ohio). Aug. 1962. 77p. (GA/Phys/62-7)

An analytical investigation of the application of the Mössbauer Effect to accelerometers is presented. Resonant absorption so obtained is sensitive to changes in photon energy of one part in $10^{12}-10^{15}$. Fundamental limitations in the application of this phenomenon are the need for statistical counting of photons and the uncertainty in the energy of the nuclear gamma decay. An order of magnitude analysis indicates that the isotope Fe(57), which has favorable characteristics such as a relatively high cross section for resonant absorption and a relatively high ratio of photon energy to uncertainty in photon energy (3×10 to the 12th power), is the best available isotope. The Mössbauer Effect is most sensitive to a shift in energy due to relative velocity between the source and absorber, allowing sensing of velocities of 1/100–1/100,000 cm/sec. Techniques are presented and analyzed that use the latter phenomenon to measure angular and linear velocity and angular position of instrument components. (auth)

36107 (AD-286925) AN INVESTIGATION OF THE USE OF RADIATION FROM RADIOISOTOPES TO MEASURE DENSITY ALTITUDE (thesis). Alexander Kratz Rupp (Air Force Inst. of Tech., Wright-Patterson AFB, Ohio). Aug. 1962. 70p. (GA/Phys/62-13)

All known methods that obtain density altimetry from the radiation of radioisotopes are reviewed and the results of testing one of the methods, small-angle-beta scatter, in an altitude chamber are reported. The range of density altitude to be measured is from 100,000 to 300,000 ft, and within this range the small-angle-beta-scatter altimeter proves to offer a satisfactory theoretical solution. After small angle scatter in air occurs, the beta radiation is recollimated and detected by an anthracene scintillating crystal and associated electronic equipment. The count rate of the apparatus is a decreasing function with increasing altitude, and it is this observation that makes the small-angle-beta-scatter gage useful as an altimeter. Testing showed that final results in an altitude chamber provide readable data from 100,000 to 210,000 ft. It is noted that the small-angle-beta-scatter-density altimeter is especially suitable for mounting in hypersonic aircraft because it samples ambient air, requires no compressibility corrections, and can be located in fuselage areas of relatively low temperature that require no special protection. (auth)

36108 (AERI-P/R-4) EXPERIMENTAL STUDY ON THE DOUBLE REFLECTION NEUTRON SPECTROMETER. Chang Sun Choi, Sae Woong Oh, and Yun Peel Lee (Atomic Energy Research Inst., Seoul). Dec. 31, 1962. 7p.

The energy spectrum of a neutron beam from a double reflection neutron spectrometer was measured and showed many sharp absorption dips. An attempt to explain the spectrum in terms of simultaneous and successive Bragg reflection from the main plane and another plane resulted in calculations that gave dips in generally good agreement with those observed. (auth)

36109 (AERI-P/R-5) PULSE HEIGHT ANALYSIS BY NEUTRAL DENSITY GELATIN WEDGE. M. K. Chung (Atomic Energy Research Inst., Seoul) and D. I. Kim (Seoul National Univ. Graduate School). Dec. 31, 1962. 7p.

Pulse stretchers which were constructed originally for the use of neutron-gamma discrimination experiments were applied to gray wedge pulse height analysis combined with Tektronix 545A oscilloscope. The glass wedge was replaced by gelatin wedge because it is cheap and easy to prepare. Various gamma ray sources were used to check linear response of apparatus to gamma energy. The results are compared with those of single channel analyzer and also various recording films were tested for the best photographic recording purpose. (auth)

36110 (AFCRL-62-630) CONVENTIONAL AND PLASMA THERMOCOUPLES. Scientific Report No. 1. Jack Davis and Giovanni Lanza (Northeastern Univ., Boston). June 5, 1962. Contracts AF19(604)-7358, AF19(604)-8462, and AF49(638)-555. 17p. (AD-287833)

Existing theory on conventional thermocouples is summarized and revised. Utilizing the concepts and ideas of irreversible thermodynamics, the Seebeck, Peltier, and Thomson coefficients are obtained by using the relations between the phenomenological coefficients. Use of the techniques of irreversible thermodynamics is demonstrated since a plasma thermocouple theory using these methods is sought. The collision term in the Boltzmann equation is assumed replaceable by a relaxation type of phenomenon, and an electron gas in a solid conductor using Fermi-Dirac statistics and a plasma using Maxwell-Boltzmann statistics are considered. With these assumptions the usual expressions for the electrical and thermal conductivities are obtained. (auth)

36111 (ANL-6738) DEVELOPMENT OF AN ELECTRICAL RESISTIVITY PROBE FOR VOID-FRACTION MEASUREMENTS IN AIR-WATER FLOW. George P. Nassos (Northwestern Univ., Evanston, Ill.; Argonne National Lab., Ill.; and Associated Midwest Universities, Lemont, Ill.). June 1963. Contract W-31-109-eng-38. 37p.

Work was done on the adaptation of an electrical probe, developed by Neal for the measurement of local void fractions in mercury-nitrogen flow, to air-water flow. The

adaptation is more difficult because of wetting of the probe by water. Various probe shapes and filming agents were employed without great success. Some improvement was obtained by means of a separate triggering circuit, but the calculated void fraction was still somewhat low compared with that measured by the gamma-ray-attentuation technique. Presumably, this is due to a finite response time of the probe, associated with the wetting of the tip; hence, further development of this technique is necessary. (auth)

36112 (BNL-6518) SOME APPLICATIONS OF THE CHASE TWO-DIMENSIONAL ANALYZER AT BROOKHAVEN NATIONAL LABORATORY. Paul F. Donovan (Bell Telephone Labs., Murray Hill, N. J., and Brookhaven National Lab., Upton, N. Y.). Nov. 6, 1962. Contract [AT(30-2)-Gen-16]. 17p. (CONF-181-1)

From Utilization of Multiparameter Analyzer Meeting, Grossingers, N. Y., Nov. 1962.

The Chase two-dimensional analyzer and its displays and operation performance are described. The applications of the Chase system are discussed for the following types of particle-particle coincidence energy measurements: two-particle final state, three-particle final state and four-particle final state. The suitability of the Chase system size and storage rate for various types of measurements is considered. (D.L.C.)

36113 (HW-75292) AN OPTICAL SCHLIEREN SYSTEM FOR ULTRASOUND IMAGING. C. E. Fitch (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Oct. 17, 1962. Contract AT(45-1)-1350. 17p.

An optical Schlieren system for obtaining images of continuous ultrasound beams in a water medium is described. The system provided beam images for ultrasonic phenomena over a frequency range of two to sixteen megacycles. Examples of applications are discussed and various Schlieren photographs are shown. Quantitative information, such as measurement of sound amplitude and direction, can be obtained by careful experimental control. However, the applications discussed have been mostly confined to qualitative studies since the method tends to integrate certain effects in the beam. The Schlieren system described has been particularly valuable as an aid for interpreting phenomena associated with Lamb-wave propagation. (auth)

36114 (IDO-16889) EVALUATION OF SURFACE-ATTACHED THERMOCOUPLES DURING FORCED CONVECTION HEAT TRANSFER. Edward Richard Oetken (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). June 17, 1963. Contract AT(10-1)-205. 88p.

Metal-clad thermocouples with a flat (spade) tip were used to measure the temperature of a 0.030-in.-thick metal plate acting as a forced convection heat transfer surface. The thermocouples were found to change the temperature of the plate at the point of attachment by 40 percent of the temperature difference between fluid and plate. This value was found to be independent of fluid velocity, heat flux, and fluid temperature. A heat transfer model of the thermocouple was developed and analyzed to determine the "effective fin height" of the thermocouple at four test conditions. A correlation is presented between the average heat transfer coefficient of the system and the "effective fin height" of the thermocouple. The model and the correlation may be used to predict the calibration factor for other systems of similar thermocouples during either heating or cooling if the heat transfer coefficient is known. An evaluation of brazing and resistance spot welding for attaching the thermocouples to the plate was made. Resistance spot welding was found to give a weak attachment with poor thermal contact between plate and thermocouple. Brazing was found to give a strong attachment with excellent thermal contact between plate and thermocouple. (auth)

36115 (LF-7) AN ELECTROSTATIC PRECIPITATOR FOR THE COLLECTION OF AEROSOL SAMPLES FOR PARTICLE SIZE ANALYSIS. Technical Progress Report. T. T. Mercer, M. I. Tillery, and M. A. Flores (Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.). July 1963. Contract AT(29-2)-1013. 17p.

An electrostatic precipitator with which a sample suitable for particle size analysis can be collected from a few cubic centimeters of air is described. It operates at a volumetric flow rate of 5 cm^3/min, equivalent to a linear velocity of 4-5 cm/sec. The entire sample is deposited in a small area on a single electron microscope grid. The ions needed for charging the aerosol particles are provided by the ionization of air molecules by beta particles from a tritium source. The precipitating electrostatic field is provided by a 2100-volt battery pack. A marked segregation of particles with respect to size makes it necessary to obtain a series of electron micrographs of the sample. However, when the electrostatic precipitator was used simultaneously with a thermal precipitator to sample the same aerosol, the particle size distribution parameters estimated by the two different methods were in good agreement. (auth)

36116 (PAN-378/I) A CORRECTION DEVICE FOR THE ELIMINATION OF THE PULSE HEIGHT INFLUENCE ON THE TIME-TO-PULSE-HEIGHT CONVERTER RESOLUTION. T. Kozłowski (Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw). Dec. 1962. 12p.

A correction device for the elimination of the pulse height influence on the time-to-pulse-height converter resolution was designed and built. This unit is described and the results of testing experiments with the γ source of Co^{60} and the fast neutron generator are presented. (auth)

36117 (ORNL-3486) THE PRINCIPLES AND MEASUREMENT OF FISSION-FRAGMENT TIMES OF FLIGHT. W. F. Mruk (Oak Ridge National Lab., Tenn.). Sept. 13, 1963. Contract W-7405-eng-26. 116p.

Thesis submitted to University of Tennessee, Knoxville.

A double time-of-flight apparatus constructed for measurements on fission fragments is described, and the theory and procedures for the measurements are outlined. The accuracy of the technique, limitations of the apparatus, and physical factors affecting the measurements are analyzed. 44 references. (D.C.W.)

36118 (PAN-396/XVIII) PIEZOELECTRIC PROBE. E. Składnik (Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw). Feb. 1963. 8p.

The main problems arising during the design of piezoelectric probes for pulse pressure measurements are discussed. A piezoelectric probe constructed from barium titanate for shock-wave research in a plasma is described. (auth)

36119 (SCDC-3041) AN IMPROVED OSCILLOGRAPHIC CAMERA TECHNIQUE FOR TIME-RESOLVED MASS SPECTROMETER DATA RECORDING. Richard T. Meyer (Sandia Corp., Albuquerque, N. Mex.). [June 1963]. Contract [AT(29-1)-789]. 7p. (CONF-189-1)

From Proceedings of the 11th Annual Conference on Mass Spectrometry, San Francisco, May 1963.

A revolving drum camera–oscilloscope data display and recording system was assembled. It provides an effective

photographic sensitivity an order of magnitude greater than that previously reported for utilization in time-resolved mass spectrometer analyses of rapidly occurring physical and chemical processes. A gas phase flash heating phenomenon, recorded with a Bendix TOF Mass Spectrometer operating at 20 kc, is cited as an application of the improved data recording system and as an example of time-saving data reduction procedures. (auth)

36120 (SCDC-3135) HIGH-RESOLUTION TELEMETRY SYSTEM FOR DIAGNOSTIC ROCKETS. R. D. Jones, J. C. Mitchell, and R. G. Scharrer (Sandia Lab., Albuquerque, N. Mex.). [July 1963]. Contract [AT(29-1)-789]. 14p. (CONF-177-1)

For Presentation at National Space Electronics Symposium, Miami Beach, Fla., Oct. 1963.

A description is given of a high-resolution rocket telemetry system which was developed for transmission to a ground station diagnostic measurements in the radiation environments produced by high-altitude nuclear explosions. Results of mechanical and radiation effects tests are given. (D.L.C.)

36121 (TID-14178(Suppl.1)) GAMMA-SCATTERING DENSITY METERS: FIELD TRIALS IN COAL. Final Report. R. A. Semmler (Chicago. Univ. Labs. for Applied Sciences). Mar. 1963. Contract AT(11-1)-712. 47p. (LAS-TR-161-58)

A commercial gamma-scattering density gage was modified for use in coal by increasing the source-detector separation to 31.3 cm to obtain a linear calibration curve for a density range of 0.9 to 1.2 gm/cm^3 and by eliminating response to low energy photons with a Ta–Cd–Cu foil filter around the Geiger tubes. Calibration data and field experience are given. (auth)

36122 (TID-17758) A QUIET, SIMPLE, INEXPENSIVE AIR-GAP SWITCH. Robin Harvey and George J. Yevick (Stevens Inst. of Tech., Hoboken, N. J.). [nd]. Contract AT(30-1)-2258. 11p.

The dielectric-surface-breakdown switch built for the Chalice preheaters consists of a Teflon chamber with a Mo wire (positive potential) passing through its sides to act as a triggering electrode. The switch has performed satisfactorily several thousands of times at 100 kamp. Closing time and jitter is less than 0.1 μsec over the operable range of 20–35 kv. The switch is also remarkably self-cleaning. (D.C.W.)

36123 (TID-17866) DISPLAYS IN MULTI-PARAMETER ANALYZERS. Curtis C. Rockwood (Argonne National Lab., Ill.). Nov. 1962. Contract [W-31-109-eng-38]. 13p. (CONF-181-2; UAC-7021)

From Utilization of Multiparameter Analyzer Meeting, Grossingers, N. Y., Nov. 1962.

Characteristics of displays are classified, and the application to multi-parameter analysis is described. Important capabilities and shortcomings of various methods are pointed out, and some techniques available but not yet utilized are suggested. Examples of several display types are given, and the relationship to memory and data organization are examined. (auth)

36124 (UCRL-7276) CALIBRATION OF STRAIN GAGES AT HIGH TEMPERATURE: SECOND REPORT. W. E. Bostwick and W. L. Russell (California. Univ., Livermore. Lawrence Radiation Lab.). Mar. 13, 1963. Contract W-7405-eng-48. 19p. (CONF-147-1)

From Instrument Society of America Conference, Chicago, Sept. 1963.

Wire grid, single-filament, and foil (including one cemented to a weldable coupon) strain gages mounted on R-235 tubing were tested in tension at 800, 950, and 1100°F. Erratic operation and/or failure on test eliminated the weldable, wire grid, and single filament gages for use on R-235 at these temperatures. The other foil gages were somewhat consistent. The ratio of average optical to average ceramic cemented gage reading at room temperature was determined. Strain due to temperature alone had no consistent relation to the results obtained at temperature under tension. The errors on the pull test were large and covered broad bands. (D.C.W.)

36125 VELOCITY SENSORS APPLY MÖSSBAUER EFFECT. Philip J. Klass. Aviation Week and Space Technol., 79: No. 11, 89; 91; 93; 95(Sept. 9, 1963).

The use of the Mössbauer effect in Fe^{57} for determining relative velocities of objects with high accuracy is described. (T.F.H.)

36126 DETERMINATION OF NEUTRON ENERGY FROM PROTON RECOIL TRACKS IN NUCLEAR PHOTOEMULSIONS BY MEANS OF A SLIDE RULE. B. M. Yakovlev and A. A. Yatis (Tomsk Polytechnic Inst., USSR). Izv. Vysshikh Uchebn. Zavedenii, Fiz., No. 3, 127-30(1963). (In Russian)

Calculations of neutron energy from 0.1 to 10 Mev from recoil proton tracks in nuclear emulsion were accomplished using a slide rule. (tr-auth)

36127 A LOCAL PILE OSCILLATOR FOR THE MEASUREMENT OF THE THERMAL ABSORPTION CROSS SECTION AT THE RFR. G. Huettel and P. Liewers (Zentralinstitut für Kernphysik, Rossendorf, Ger.). Kernenergie, 6: 336-42(July 1963). (In German)

A local pile oscillator was constructed in the thermal column of the Rossendorf research reactor to measure the thermal absorption cross section. The apparatus is designed for extreme sensitivity and good elimination of the scattering effect in contrast to the absorption effect. The measurement accuracy is <1%, and the sensitivity is 0.03 mm^2. The magnitude $\Delta i/i$ proportional to the absorption cross section was maintained by simultaneous measurement of the oscillator signal Δi and of the output signal i modulated by the oscillation. For calibration, materials with cross sections from 10^{-2} to 10^2 barn were measured. The values obtained were as follows: In, 194 ± 1.1; Au, 98.5 ± 0.6; Ag, 62.9 ± 0.4; Mn, 13.3 ± 0.08; N, 1.79 ± 0.01; and Mg, 0.061 ± 0.009 barn. Boron ($\sigma_{a\,2200}$ = 755 barn) was used as standard. The self-shielding was avoided by solution of the tube in heavy water. (tr-auth)

36128 PRINCIPAL ELECTRONIC CHARACTERISTICS OF THE INSTRUMENTS EMPLOYED IN NUCLEAR TECHNOLOGY AND THE DETERMINATION OF THESE CHARACTERISTICS. PART I. Antal Csakany, Ferenc Szlavik, and Ferenc Vajda. Meres es Automat., 11: 160-6(1963).

Consideration is given to amplifiers and the characteristics obtainable from the analysis of the input and output signals; factors influencing the amplification; instruments required for the evaluation of amplifiers; measuring impulse amplitude by direct-current oscilloscope and by compensated-diode discriminator; determination of the characteristics of input and output signals; determination of the overload factor; and measurements of noise are discussed. (TCO)

36129 CHARGE CONTROLLED NANOSECOND LOGIC CIRCUITRY. Brian E. Sear (Martin Co., Baltimore). Proc. IEEE (Inst. Elec. Electron. Engrs.), 51: 1215-27 (Sept. 1963).

Nanosecond circuitry can be based mainly on two de-

vices—the transistor and the tunnel diode. Unfortunately, the speed advantages of the tunnel diode cannot be utilized because the current gain is limited by practical tolerance requirements. Therefore, any circuits designed "around" these two devices are either practical, but limited to the speed of the transistor, or impractical, for general purpose logic, with the speed performance of the tunnel diode. The region of the tunnel diode gain bandwidth curve that is limited by tolerances can be exploited by using a storage diode as an interstage current amplifier or charge transformer. The operation of the storage diode is discussed, and charge gain bandwidth criteria are developed from the physical equations describing the device. Charge control switching curves are developed for the tunnel diode that define its operation as a charge amplifier. The combination of tunnel diode and charge transformer (TDCT). Logic enables a wide variety of logic functions to be obtained with a gain bandwidth tolerance performance previously unattainable in nanosecond logic circuitry. To demonstrate this capability a "NOR" circuit is described and a worse-case analysis of the fan-out tolerance performance is given. (auth)

36130 AN ISOTOPIC DENSITY METER FOR INDUSTRIAL WATERS. Rudolf Burek, Ryszard Lach, Jan Lasa, and Jerzy Sawicki. Przegląd Górniczy, 18: 185-9(1962).

The theory of the noncontact measuring method, based on γ-ray absorption in the test medium, is briefly explained. The layout and mode of operation of a laboratory apparatus for measuring the density of emulsions in flotation processes are described. The radiation source is located before the pipeline carrying the liquid to be checked. The detector comprises a scintillation counter with a NaI/Tl crystal, a photomultiplier, an integrating circuit, and a measuring device that includes a self-recorder. The current is supplied from a high voltage source. Results and conclusions from laboratory and industrial experiment measurements are given. It was found that the results are of a qualitative nature, the apparatus being suitable for continuous measurements. The method does not require any special adjustments of the pipeline system. (Referativnyy zhurnal. Khimiya, No. 22, 1962)

36131 SCANNING AND MEASURING PROJECTOR (Engineering Materials). (California. Univ., Berkeley. Lawrence Radiation Lab.). (CAPE-1017)

This package contains 339 drawings. The Scanning and Measuring Projector (SMP) is used to perform the rapid measurement of interactions and decays of elementary particles that take place in the 0.72 in. liquid hydrogen bubble chamber. An on-line computer is used to swiftly process large quantities of data. The computer's speed makes it possible to evaluate the tracks as they are being measured. If a track measurement is not acceptable, it is rejected immediately and can be remeasured. An IBM typewriter is used for communication with the computer. The SMP uses modern data processing equipment, which is easy to operate and simple to maintain. (F.L.S.)

36132 GAMMA ABSORPTOMETER—COBALT SOURCE (Engineering Materials). (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). (CAPE-873)

This package contains 2 drawings and 2 photographs. The 700 millicurie Co^{60} source for the absorptometer is contained in a lead filled cask 15 in. in dia. and 21 in. tall. The beam from the Co^{60} source is collimated to $\frac{3}{8}$ in. in dia. The detector used in the absorptometer is NaI(Tl) crystal optically coupled to a photomultiplier tube which is connected to a V micromicroammeter. The output of the micromicroammeter is recorded on a variable span Brown recorder. The sensitivity of the system is such that a $\frac{1}{2}$ in. dia Zircaloy-2, swaged UO_2 fuel rod of 84.6% theoretical density (TD) allows a current of 0.7785 μa, while a similar specimen of 87.7% TD allows a current of 0.7785 μa. The current can be measured with an accuracy of ±0.001 μa. The detection limit for this particular sample dia. and beam size is 0.15% TD. (F.S.)

36133 THE ATLAS QUADRUPOLE MASS SPECTROMETER. C. Brunnée, L. Delgmann, and K. Kronenberger (Atlas Mess- und Analysentechnik GmbH, Bremen). 13p. (CONF-74-19)

From 11th Annual Conference on Mass Spectrometry and Allied Topics, San Francisco, May 1963.

Construction and performance data of a new quadrupole mass spectrometer for analyses of residual gases in high- and ultra-high-vacuum systems are given. The quadrupole tube with its length of 20 cm and weight of 7.3 lb is of all-metal construction, offering a simple and compact design. The tube is bakeable up to 450°C. Because the mass separation is performed via a high-frequency field the use of a deflecting magnet is not necessary. The mass range is from 1 to 100 amu with a resolution of approx. $M/\Delta M = 100$. For 100% transmission the sensitivity is about 2×10^{-4} A/torr; the smallest detectable partial pressure is in the region of 10^{-13} torr. (auth)

36134 SURFACE IONIZATION MICROSCOPE. A. B. Marchant, G. Kuskevics, and A. T. Forrester. New York, American Institute of Aeronautics and Astronautics, 1963, Preprint 63018, 19p. (CONF-10-30)

From Electric Propulsion Conference, Colorado Springs, Colo., Mar. 1963.

A surface ionization microscope was developed for the study of cesium ionization on porous refractory metal structures. The microscope consists of an ionizer-cesium reservoir unit, electrostatic immersion lens, an ion-electron image converter, and a phosphor screen. The ionizer can be heated to 1400°C. The cesium reservoir has a separate heater and thermocouple probe. The ionizer surface forms the first element of a three element electrostatic immersion lens. The second and third elements are part of a fixture which can be moved along the optical axis of the system. By adjusting the position and the voltage ratios of the elements magnifications of the ionizer from 25 to 200× are obtained. A traversing mechanism is employed to move the ionizer and permit scanning over the ionizer surface. All these adjustments can be made during operation of the microscope. The ion-electron converter is an electro-formed nickel screen, held at ground potential. It is placed in front of an aluminized phosphor which is maintained at +10 kv. Ions incident on the nickel screen produce secondary electrons which are pulled through the open areas and accelerated into the phosphor by the electrostatic field. The microscope was used to observe both ion emission and electron emission from various ionizers. Results from tungsten wire bundles and commercial sintered tungsten powder are presented. Both show wide variations in surface ion emission. The wire bundle is seen to operate under three conditions simultaneously. An analytical solution which explains this phenomenon is pointed out. The ion microscope gives a picture which immediately shows the distribution and uniformity of ion emission from a surface ionizer and allows one to observe the effects of pore size, crystal orientation, gas adsorption, braze penetration, and other pertinent characteristics. (auth)

36135 IMPROVEMENTS RELATING TO METHODS OF MANUFACTURING ELECTRIC DISCHARGE TUBES. (to Philips Electrical Industries Ltd.). British Patent 935,164. Aug. 28, 1963. Priority date Nov. 25, 1960, Netherlands.

An electric discharge tube, which is provided with an H replenisher, and a method of manufacturing it are patented. The tube and electrodes are degassed, and the H-replenisher component is then coated with a finely divided metal by atomization in a rare-gas glow discharge or by vaporization in a rare-gas atmosphere. The finely divided metal may be Zr or Ti and is capable of reversibly absorbing H. After being coated on the H replenisher, which is a thin-walled metal sheath surrounding a heater, it is saturated with H, and any excess gas is removed from the discharge tube. The H replenisher is particularly useful in a neutron generator, which is divided into 2 parts by an apertured partition, each part being provided with a replenisher. (M.P.G.)

36136 FAST OPENING SWITCH. M. Bender, F. K. Bennett, and A. F. Kuckes (to U. S. Atomic Energy Commission). U. S. Patent 3,104,295. Sept. 17, 1963.

A fast-acting electric switch is described for rapidly opening a circuit carrying large amounts of electrical power. A thin, conducting foil bridges a gap in this circuit and means are provided for producing a magnetic field and eddy currents in the foil, whereby the foil is rapidly broken to open the circuit across the gap. Advantageously the foil has a hole forming two narrow portions in the foil and the means producing the magnetic field and eddy currents comprises an annular coil having its annulus coaxial with the hole in the foil and turns adjacent the narrow portions of the foil. An electrical current flows through the coil to produce the magnetic field and eddy currents in the foil. (AEC)

Radiation Detection

Refer also to abstracts 36347, 36418, 36420, 36421, 36422, and 36426.

36137 (AD-289692) THE DEVELOPMENT OF THE SILICON-JUNCTION FAST-NEUTRON DOSIMETER FOR APPLICATION IN THE RADIATION-EFFECTS TESTING RANGE. Final Summary Report, June 1, 1961 to September 30, 1962. O. J. Mengali, W. H. Closser, and H. C. Gorton (Battelle Memorial Inst., Columbus, Ohio). Sept. 30, 1962. Contract DA-18-108-405-1031. 32p.

Experimental silicon-junction fast-neutron dosimeters were prepared with crystal type, base width, surface work damage, and a process modification to increase initial charge-carrier lifetime as variable parameters. Examination of the preirradiation characteristics of the devices revealed several unexpected effects related to the material and process variables. To accurately determine the neutron exposure of the experimental dosimeters, a complete independent calibration was made of the flux spectrum of the reactor at the core position used in the irradiations. Six fission foils and threshold detectors with threshold energies from 4 kev to 6.9 Mev were used. In^{115} foils and S^{32} pellets were included with the experimental dosimeters in each of the irradiations. The narrower base devices were shown to be much less sensitive to fast-neutron irradiation than the wider base devices. Although the sensitivity of the device to irradiation was not linear, the nonlinearity was generally less than 20% from 10^{12} to at least 10^{13} nvt. It was observed that neither surface treatment nor lifetime retention process had a significant effect on the sensitivity of the devices. (auth)

36138 (AD-295620) EFFECT OF DETECTOR HEIGHT AND COLLIMATION ON THE MEASUREMENT OF FALL-OUT RADIATION. Technical Note No. 62-4. E. W. Jones (Canada. Defence Research Chemical Labs., Ottawa). Mar. 1962. 15p.

These notes are based upon theoretical information abstracted from an unpublished report and it must be noted that the data apply to various postulated ideal conditions. The solutions are presented in the form of "dose angular distributions" which specify the radiation dose rate received by a detector in terms of the contributions received by the detector in the various angular directions. In this form the information may be readily used to calculate the response of a detector having any "acceptance" aperture. The postulated infinite homogeneous medium case differs only slightly from that of an ideal air-ground interface so that no great inaccuracy results from applying this basic data to the more practical case. However, since in practice the air-ground interface will not be ideal, a concept of a "ground roughness" factor is necessary and will be introduced later. For the analysis of the aerial survey problem the relevant basic data have been, in most cases, transformed into a form more directly applicable to the problem. The response of a radiation detector carried by an aircraft flying over a contaminated area will obviously depend upon many factors and the problem of transforming this measured response into a corresponding ground dose rate associated with the area under survey admits of approximate estimates only. (auth)

36139 (AD-295747) A SOLID STATE POCKET RADIATION DETECTION SYSTEM. Final Report, September 1, 1961 through November 30, 1962. Norman A. Baily and Frederick W. Cleary (Hughes Research Labs. Div. of Hughes Aircraft Co., Malibu, Calif.). Contract DA-49-193-MD-2194. 25p.

A pocket-size radiac instrument was designed to operate with silicon p–i–n junction detectors. These detectors are sensitive to both x or gamma radiation and also to charged particles including alpha particles. The electronic system can read out counting rates in the range of zero to 100,000 counts/min in four linear decades. A large, flat detector is mounted into the back surface of the case. A plug-in probe using a cylindrical detector is furnished for possible insertion into small volumes in the body or in open wounds. Both detectors are protected by a silicon monoxide coating. Discrimination between pulses due to alpha or other heavily ionizing particles and those due to photons or betas is provided. The unit, therefore, combines two separate sensitive volumes: (1) A large area detector (approximately 6 sq. cm. which can detect very low levels of radioactivity. This detector will allow a monitor to scan the surface and clothing of persons suspected of radioactive contamination. (2) A probe, which is 3 mm in diameter at the tip and 3 feet in length, which plugs into a receptacle on the top of the case, and is designed so that it can be sterilized and therefore can be inserted directly into an open wound. Absolute sensitivity over that reported can be increased if discrimination between heavily ionizing particles and photon radiation is eliminated. (auth)

36140 (AE-116) CALCULATIONS OF TOTAL AND DIFFERENTIAL SOLID ANGLES FOR A PROTON RECOIL SOLID STATE DETECTOR. J. Konijn, A. Lauber, and B. Tollander (Aktiebolaget Atomenergi, Stockholm). Aug. 1963. 31p.

The solid angles were computed for a proton recoil counter consisting of a circular hydrogenous foil viewed by a circular solid state counter when using an isotropic neutron point source at different distances from the target

foil. Tables are given for the total subtended solid angle as well as the differential energy distribution function of the proton recoil spectrum. The influence of finite foil thickness was also studied. (auth)

36141 (AE-118) MEASUREMENTS OF SMALL EXPOSURES OF GAMMA RADIATION WITH $CaSO_4$:Mn RADIOTHERMOLUMINESCENCE. Bengt Bjaerngard (Aktiebolaget Atomenergi, Stockholm). Aug. 1963. 18p.

A system for measurements of small exposures of gamma radiation using $CaSO_4$:Mn thermoluminescence was developed. The construction and performance of a read-out apparatus is described as well as the construction and characteristics of a simple dosimeter. The reproducibility of the method at various exposures is estimated. 20 μr of 1 Mev gamma radiation can be measured with a reproducibility within ±50% (standard deviation). (auth)

36142 (AEEW-R-274) THE CHARACTERISTICS OF AN RC6 IONISATION CHAMBER WITH A LOW POLARISING VOLTAGE FOR THE COMPENSATING VOLUME. D. L. Roberts (United Kingdom Atomic Energy Authority. Reactor Group. Atomic Energy Research Establishment, Winfrith, Dorset, England). May 1963. 19p.

Compensated ionization chambers are often used for reactor experimental and control measurements. Serious fault conditions can arise in the use of these chambers since operation in gamma fields other than those in which they are calibrated can cause changes in the original compensation ratio even to the extent of overcompensation; and certain faults in the polarizing supply can cause the measuring instrument to drift wildly and can, in some conditions, result in damage to the instrument. A procedure for the operation of an R.C.6 chamber is described which reduces but stabilizes the compensation ratio and at the same time offers considerable protection to the measuring instrument. This is achieved by suitable low voltage polarization of the gamma compensating volume. (auth)

36143 (AERE-R-4269) THE USE OF STILBENE, WITH DECAY TIME DISCRIMINATION, AS [IN] A FAST NEUTRON SPECTROMETER. M. McN. Wasson (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). June 1963. 56p.

The use of stilbene crystals in a spectrometer for fast neutrons in the region of 1 to 20 Mev is described. The effects of various inherent and instrumental parameters on the response as well as the effects of high γ backgrounds and their suppression are discussed. (auth)

36144 (AFCRL-62-1070) RECENT ADVANCES IN THE USE OF THE ELECTRON SPECTROMETER. Scientific Report No. 4. Edwin N. Lassettre, Frederic M. Glaser, Vincent D. Meyer, and Ausma Skerbele (Ohio State Univ. Research Foundation, Columbus). Sept. 1962. Contract AF19(604)-4541. 22p. (AD-289826)

The stability, resolution, and electron beam current of the electron spectrometer in use was increased. This was accomplished by heating the entrance and exit slits of the velocity analyzer used for velocity selection before scattering and by substituting a short slit (width is half the diameter of the pinhole) for the exit pinhole and entrance slit of the velocity analyzer. Excitation potentials and the relative intensities of peaks obtained by electron impact are discussed briefly and compared with optical data. Electron impact spectra of helium, nitrogen, nitric oxide, and carbon dioxide are included. (auth)

36145 (ASD-TDR-62-838) THE APPLICATION OF SEMICONDUCTOR RADIATION DETECTORS TO THE OBSERVATION OF FAST NEUTRONS. E. L. Zimmerman, G. Baladjanian, A. Brainard, L. Wang, and R. M. Olson (Solid State Radiations, Inc., Los Angeles). Aug. 1962. Contract AF33(616)-8340. 52p. (AD-294329)

Several methods of utilizing a semiconductor radiation detector for neutron observations were investigated. Techniques for the application of neutron-sensitive materials to detector surfaces were developed and the resulting coated detectors were evaluated as both thermal and threshold detectors. A good geometry proton-recoil spectrometer utilizing a semiconductor detector was built and used to observe fast neutrons. An analytical study of this device resulted in a method which can accurately predict its response as a function of incident neutron energy, hydrogenous radiator thickness, and system geometry. Good qualitative agreement was observed between the predicted and experimental response. Efforts to introduce Li^6 into the sensitive region of a detector in order to make the detector neutron-energy-sensitive by means of the $Li^6(n,\alpha)T^3$ reaction have not been successful to date. However, this effort contributed substantially to the development of the lithium ion drift detector. (auth)

36146 (CERN-63-25) A TELESCOPE TO IDENTIFY ELECTRONS IN THE PRESENCE OF PION BACKGROUND. T. Massam, Th. Muller, and Z. Zichichi (European Organization for Nuclear Research, Geneva). June 27, 1963. 12p.

A telescope that considerably reduces the probability of mistaking a pion for an electron of the same momentum is described. It consists of a thick lead slice followed by a thick scintillation counter, and a lead glass Cherenkov counter. The counters accept only the large pulse heights due to cascade showers produced by electrons in the lead. (D.C.W.)

36147 (CRRIS-1150) A REMOTELY-CONTROLLED PINHOLE GAMMA CAMERA. R. J. Beal (Atomic Energy of Canada Ltd., Chalk River, Ont.). Nov. 1, 1962. 18p. (AECL-1801)

A gamma pinhole camera developed to locate areas or objects emitting high levels of gamma radiation is described. The camera, operated from a remote control panel, records optical and gamma images on successive frames of a highly sensitive 35 mm panchromatic film. Area lighting for optical exposures is obtained from an electronic flash unit. A bakelite shutter remains closed during gamma exposures. (auth)

36148 (HW-70951) A TRANSISTORIZED POCKET RADIATION DOSIMETER WITH AURAL ALARM. G. W. Masden (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Sept. 15, 1961. Contract [AT(45-1)-1350]. 14p.

The prototype of a transistorized pocket radiation dosimeter with audible alarm was developed and tested. Though all tests are not complete, the tests which have been carried out indicate reliable performance. Some minor problems involving the effects of severe thermal transients are being corrected. The device is satisfactory for general operation over the range of the incorporated modified pencil dosimeter. Typically, this range is 0 to 200 mr although, quite obviously, higher range units can be fabricated. Continuous operation battery life approaches 60 to 80 hours although judicious battery selection can easily extend this to be in excess of 100 hours. By selective dosimeter chamber charging, the alarm point can be controlled for any point over the operational range of the sensor. The modified sensor employs an illuminated quartz fiber, a machined slit past which the slowly dis-

charging fiber moves to activate the incorporated transistor circuitry, and a secondary sensor used for temperature compensation of the basic sensor. Operation is simple, reliable, and positive and the mechanical ruggedness is limited only by the actual pencil dosimeter used. (auth)

36149 (HW-78193) LIQUID EFFLUENT MONITOR FOR RADIONUCLIDES. E. M. Sheen (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Aug. 1, 1963. Contract AT(45-1)-1350. 25p.

A sensitive, reliable liquid effluent monitor for gamma-emitting radionuclides was developed for use at the Plutonium Recycle Test Reactor at Hanford. The instrument (which uses a scintillation detector, solid-state circuitry, a four-decade logarithmic response count rate meter, and an additional direct metering circuit) was developed to monitor the desired range from approximately 10^{-4} gamma μc/ml to 5 gamma μc/ml. The detector scintillator is a 2-in.-diameter by 2-in.-long cylinder of terphenyl in polyvinyltoluene. The multiplier phototube anode is capacitively coupled to the pulse amplifying and counting instrumentation and is also directly coupled to additional circuitry that provides linear high radiation level indication and an electronic alarm trip. This dual method provides a sensitive pulse counting circuit combined with a direct coupled linear circuit to prevent possible a-c blocking at high radiation exposure. (auth)

36150 (IS-606) GAMMA RAY EFFICIENCIES FOR WELL TYPE SCINTILLATION CRYSTALS. Ronald S. Dingus and M. G. Stewart (Ames Lab., Ames, Iowa). Feb. 8, 1963. Contract W-7405-eng-82. 10p.

Gamma ray efficiencies for various sized well type NaI(Tl) crystals were calculated using an IBM 704 digital computer. The adjustable parameters in the program are the gamma ray energy, the heights and diameters of the crystal and of the well, the thickness of the well lining, and the position of the (point) source inside the well. Some typical results are presented in graphical form. (auth)

36151 (LADC-5906) DISCRIMINATION DEPENDENCE OF A PHOSWICH SYSTEM ON THE INTEGRATING TIME CONSTANT. Richard L. Crawford (Los Alamos Scientific Lab., N. Mex.) and Ahmed Erteza (New Mexico. Univ., Albuquerque). [nd]. Contract [W-7405-eng-36]. 12p. (CONF-182-1)

From 9th Scintillation and Semiconductor Counter Symposium, Washington, D. C., Feb. 1963.

The theoretical maximum ratio of pulse heights from fast and slow scintillation phosphors in a phoswich system is degraded by the transit time spread of the photomultiplier and the integrating time constant of the output circuit. Presented is a mathematical treatment to obtain the ratio of the pulse heights from general equations that are developed. The results of this analysis for a typical phoswich consisting of a plastic scintillator and a CsI(Tl) crystal show that for each photomultiplier transit time spread there is an optimum integrating time constant. Graphs are included to show the relative pulse heights and the time spread between the fast and slow voltage pulses as a function of the integrating time constant. (auth)

36152 (LADC-5953) THE TOTAL ENERGY SCINTILLATION SPECTROMETER. H. Motz (Los Alamos Scientific Lab., N. Mex.). [1963]. Contract [W-7405-eng-36]. 8p.

The spectral response of a scintillation spectrometer may be improved by rejecting all events that are not total energy events. This rejection is usually accomplished by surrounding the analyzing crystal with a large counter volume so that events associated with energy loss in the outer counter are suppressed by an anti-coincidence signal. Crystal assemblies having the analyzing crystal surrounded by a NaI annulus are being used for neutron capture spectra, and the assembly at the Omega West Reactor at Los Alamos is described briefly. Representative spectra are given for D_2O, graphite, and Ne. (D.L.C.)

36153 (LADC-5954) MAGNETIC SPECTROMETERS FOR THE STUDY OF NEUTRON CAPTURE SPECTRA. H. Motz (Los Alamos Scientific Lab., N. Mex.). [1962]. Contract [W-7405-eng-36]. 11p.

The advantages and limitations of spectrometers for analyzing electrons from the photoelectric, external pair, and Compton conversion processes are reviewed. The design and performance of some actual spectrometers are described, and data analysis and neutron binding energy determination are considered. (D.C.W.)

36154 (ORNL-TM-653) ENERGY RESPONSE, GAMMA DISCRIMINATION AND STABILITY OF THE ORNL MODEL Q-2047 FAST NEUTRON SURVEY METER. E. D. Gupton and S. Fukushi (Oak Ridge National Lab., Tenn.). June 12, 1963. Contract [W-7405-eng-26]. 6p.

The energy response, in terms of the NCRP rem dose, was determined for the ORNL Model Q-2047, Fast Neutron Survey Meter. Within the neutron energy range 0.15 to 5 Mev, the response of the instrument was found to be within 25 per cent of the NCRP values. The gamma radiation discrimination was excellent and no drift in the response during continuous use for eight hours was detected. (auth)

36155 (WCAP-2346) MINIATURE NEUTRON DETECTOR DEVELOPMENT. Quarterly Progress Report, April 1–June 30, 1963. J. Weisman, ed. (Westinghouse Electric Corp. Atomic Power Div., Pittsburgh). Work Performed under United States–Euratom Joint Research and development Program. Contract AT(30-1)-2827. 17p. (EURAEC-764)

Silicon carbide diodes are now used to detect thermal neutrons. This was accomplished by detection of fission fragments from a U^{235} film placed over the surface of the diodes and exposed to a thermal neutron flux. The two diodes tested showed excellent detection of the fission fragments produced. One diode used had been subjected to a high radiation dose which had virtually destroyed its α counting ability yet it still adequately detected fission fragments. Relative ratings are assigned to the counting ability of the various diodes tested to date. These were used to attempt to determine what relationship exists between counting ability and other properties or fabrication procedure. The best diodes produced were obtained from high resistivity crystals which are infinite source diffused and have junction areas less than 10^{-2} cm^2. Increased emphasis is being placed on very high temperature annealing. To make this possible high temperature contacts will be required. Work on the use of tungsten as a contact material is beginning. (auth)

36156 (TID-17493) A STATISTICAL PROBLEM IN THE THEORY OF COUNTERS. G. P. Steck (Sandia Corp., Albuquerque, N. Mex.). Dec. 1962. Contract AT(29-1)-789. 15p. (SCDC-2964)

A treatment is presented of the case in which a counting device records the number of radioactive decays in each of n successive time intervals of length τ. The treatment derives the maximum likelihood estimate (MLE) and the minimum chi-square estimate (MXE) of the decay parameter, derives approximate formulas for the variances and biases of these estimates, and discusses the choice of an optimum τ. Since the approximate variances of the two

estimates are the same and since the MLE has smaller absolute bias near the optimum τ, the MLE is considered superior to the MXE. The effect of background on the variance and bias of the MLE is studied. Finally, a modification of the MLE is presented which compensates for the effect of counter dead time. (auth)

36157 EXPERIENCES WITH AN IMPROVED DESIGN FOR A CLINICAL GAMMA WELL DETECTOR. E. H. Cranswick, N. Griffin, and F. Gorton (Rockland State Hospital, Orangeburg, N. Y.). Am. J. Med. Electron., 2: 21-7(Jan.-Mar. 1963).

Development of a counter for measuring low levels of I^{131} activity in serum, urine, saliva, and other biologic fluids is described. Preliminary trials of various designs showed that some of the factors affecting stability in counting are unstable high voltage supplied to the photomultiplier tube, unstable temperature maintenance in the counting room, and unsuitable positions on the pulse height discriminator (such that a count is made over a sharp peak of activity). Among factors which raised the background, was insufficient shielding, both from above and from below. In regard to the shielding above the crystal, it was found that although a sufficient amount of lead might be posed vertically over the crystal, there was a high background because of the incidence of oblique and scattered cosmic radiation on the sides. A convenient shielding system was devised wherein the detector element was moved by a hand-wound gear up and down into a lead castle. The upper part of the detector is a 250-lb mass of lead largely within an 8-in. steel pipe. This pipe was filled with poured lead and then with lead rings. Mounting of the detector element and the electronic circuit is described in detail. Operational characteristics of the detector are discussed with regard to temperature changes, background, sensitivity, efficiency, and stability. (BBB)

36158 DETERMINATION OF THE TIME CONSTANTS OF SCINTILLATORS. Gerard Pfeffer, Hans Lami, Gilbert Laustriat, and Andre Coche (Centre de Recherches Nucleaires, Strasbourg). Compt. Rend., 257: 434-7(July 8, 1963). (In French)

A device for the determination of the time constants of scintillators in which the fluorescence is excited either by nuclear particles or by ultraviolet radiation is described. The time constant values of some solutes are given, and the case of toluene–diphenyloxazole solution is considered in some detail. (tr-auth)

36159 PRELIMINARY RESULTS OF A WORLD SURVEY OF WHOLE-BODY MONITORS. H. G. Mehl (International Atomic Energy Agency, Vienna) and J. Rundo. Health Phys., 9: 607-14(June 1963).

A survey was made on whole-body monitors in operation by the end of 1961 and expected to be in operation in the first half of 1962. The compilation of preliminary results includes information on the main uses, world distribution, technical data, and efficiency data. On the basis of the background and sensitivity values reported, an estimate was made of the detection limit of such apparatus for contaminants in the human body. (auth)

36160 INSTRUMENT REQUIREMENTS FOR PEACETIME ACCIDENTS INVOLVING RADIOACTIVITY. A. L. Baietti (Tracerlab, Richmond, Calif.). Health Phys., 9: 635-42(June 1963).

Consideration is given to the instrument requirements for peacetime accidents involving radioactivity. Analysis of the problem is directed at determining the requirements for measuring the radiation field, the contamination level, and personnel exposure. A general description of the characteristics of the various instrument systems used in these measurements is presented. Recommendations are made on instrumentation development needed to make the measurements necessary for assessing the significance of the radiological environment associated with a peacetime accident involving radioactivity. (auth)

36161 PORTABLE 2π FLOW COUNTER FOR THE DETECTION OF α AND β PARTICLES IN SMEAR SAMPLES. L. Costrell, A. Schwebel, and G. W. Zimmer (National Bureau of Standards, Washington, D. C.). Health Phys., 9: 643-5(June 1963).

A portable 2π flow counter was developed for counting α and β particles in smears. The instrument has proved useful in on-the-spot analysis of accidental spills and in routine smear tests. (auth)

36162 EARLY DETECTION OF CONTAMINATION BY THE USE OF GAS PROPORTIONAL MONITORS. J. G. Ello (Argonne National Lab., Ill.). Health Phys., 9: 653-5(June 1963).

The use of gas proportional monitors is recommended for on-the-spot monitoring of personnel in radiochemistry laboratories. Design features of gas-flow proportional detectors are reviewed. (C.H.)

36163 PHOTOGRAPHIC FILM MEASUREMENT OF THE LONG-TERM RADIATION EXPOSURE AROUND A CHIMNEY DISCHARGING RADIONUCLIDES. H. H. Ph. Moeken and J. J. H. Alderhout (Eurochemic, Mol, Belg.). Health Phys., 9: 655-6(June 1963).

The use of a number of photographic film detectors at many places in the environment is recommended for the measurement of long-term radiation exposure around chimneys discharging radionuclides. (C.H.)

36164 AN OPTICAL DEVICE FOR EXTENDING THE RANGE OF FILM MEASUREMENTS OF GAMMA RADIATION. Allen Brodsky (Univ. of Pittsburgh). Health Phys., 9: 656-63(June 1963).

An optical density amplifier is described that was designed to extend the range of photographic film detectors exposed to low doses of γ radiation. (C.H.)

36165 A DEAD-TIME ELIMINATED QUENCHING CIRCUIT FOR GEIGER-MÜLLER COUNTING TUBES. Bela Makranczy. Magy. Tud. Akad. At. Kut. Int. (Debrecen) Közlemén., 3: 195-202(Dec. 1961). (In Hungarian)

A circuit consisting of a multivibrator with continuous operation suppressed by a large negative prevoltage is described. It eliminates operational uncertainty by retaining the signal of the counter during the dead-time, ensuring a satisfactory operation after the lapse of the dead-time period. Instruments filled with various rare gases and connected to a number of the extinction circuits were tested under filled conditions. (TCO)

36166 THE ENERGETIC CHARACTERISTIC OF IONIZATION CHAMBERS (TYPE KID) DESIGNED FOR DIAGNOSTIC AND THERAPEUTIC X-RAY APPARATUS. Wlodzimierz Lobodziec. Polski Przeglad Radiol. i Med. Nuklearnej, 27: 347-52(1963). (In Polish)

The energy dependence characteristics of ionization chambers were determined for x rays generated in the range from 50 to 250 kev with various filtrations (Cu + Al), (Sn + Cu + Al), (simple Al) and used for diagnostic and therapeutic purposes. Tables and charts depict the results of measurements. (auth)

36167 MINIATURE BF_3 PROPORTIONAL COUNTERS ENCASED IN ALUMINUM. Adam Kazimierski. Przeglad Elektron., No. 7, 393-7(1962).

An experimental series of counters was made with active lengths of 30 and 50 mm, and internal diameters of 4 and 8 mm in order to determine the influence of miniaturization upon their characteristics. A schematic drawing shows the construction of the counter. Its cathode is made of pure Al (99.8%). The amplitude distribution increases, and the most probable pulse amplitude decreases for the miniature counters. The length and slope of the plateau are satisfactory and are only slightly worse than that of normal size counters. For plateau length not less than 50 v and slope of not more than 15%, the maximum gamma radiation level for ϕ (diameter) = 8 mm and l = 30 mm is 3×10^4 r/hr, while for ϕ = 4 mm and l = 30 mm it is 8×10^4 r/hr. The technical parameters of the counters are listed. (OTS)

36168 POTENTIAL AND FIELD IN A CYLINDRICAL BASIN-CHAMBER FOR THE ABSOLUTE DETERMINATION OF THE STANDARD ION DOSE. M. Peschel and K. Willuhn (Physikalisch-Technische Zentralinstitut des Deutschen Amtes fÜr Messwesen, Berlin). Radiobiol. Radiotherap., 4: 73-83(1963). (In German)

A new ionization chamber is described for measuring the standard isodose. The electrodes consist of 2 cylindrical shells separated by slits opposite to each other. The potential and field are calculated in the interior of the chamber in order to be able to determine the form of the potential rings and the electric field strength. The electric field strength of the chamber is given for different slit breadths and compared to the field in a cask chamber. (auth)

36169 HIGH DOSE FERROUS DOSIMETRY FOR Co γ-RAYS. Gisuke Meshitsuka and Takeshi Sawai. Tokyo Metropolitan Isotope Centre Ann. Rept., 1: 71-4(1962). (In Japanese)

A simple method of high level Co^{60} γ-ray dosimetry was studied, using ferrous ammonium sulfate-sulfuric acid solution, without degassing or nitrogen subsitution. The relationship between the irradiation dose and the ferric ion concentration produced was examined in the presence of various concentrations of solutes. The linear relationship thus obtained in the oxygen exhausted region can be extended to higher doses by higher concentration of ferrous ammonium sulfate and sulfuric acid. In a system of 0.5 mole/l ferrous ammonium sulfate in 5N sulfuric acid, the linearity is kept up to 1.2×10^7 r. The oxidation yield of ferrous ion, however, decreases with increasing solute concentration. (auth)

36170 MEASUREMENT OF DOSE RATE DISTRIBUTION BY GLASS DOSIMETRY. Gisuke Meshitsuka, Yoshiharu Shinozake, and Hiroshi Suguro. Tokyo Metropolitan Isotope Centre Ann. Rept., 1: 75-7(1962). (In Japanese)

In order to get a homogeneous irradiation of a sample, a simple method using a modified glass dosimeter was devised to measure the dose rate distribution around a 1000-C source. Glass with a quality of a deck glass, thickness 1.5 mm, was cut into pieces of 25 × 157 mm each, and set parallel to the source. Irradiation was made at two different positions, 25 and 50 mm from the source, and the optical density of the irradiated sample at 400 mμ was measured by a photoelectric photometer with a densitometric attachment. A cylindrical zone of homogeneous dose rate, about 100 mm long, was found to exist around the Co^{60} source. As fading was observed in all irradiated samples, its effect on the applicability of the method was investigated at various conditions. The rate of fading in irradiated glass was measured by its optical density at various temperatures, 23, 64, 100, and 130°C, and the apparent activation energy of the fading was calculated both in an initial state and in a state where the optical density decreased to one half of the initial value. The results show that the fading sometimes causes error in the determination of absolute dose rate, but that the error is negligible in the measurement of relative dose rate distribution. (auth)

36171 SEMICONDUCTOR NUCLEAR-RADIATION DETECTORS. SILICON JUNCTION DETECTORS OF GOOD RESOLUTION, LONG-TERM STABILITY AND FAST RISE TIME; SUITABLE FOR NUCLEAR RESEARCH. Jitsuo Terada, Yasuo Ebara, Juzo Yoshida, and Tetsuji Kobayashi (Tokyo Shibaura Electric Co., Ltd.). Toshiba Rev. Intern. Ed., No. 14, 34-9(1963). (In English)

Characteristics of the silicon junction detector and some examples of its applications to radiation detection are described. The range of effective detection was improved and its application to β and γ measurements was expanded. Work was carried out toward the development of a series of radiation detectors including a lithium-ion drifted silicon (germanium) detector. (auth)

36172 4π-COUNTER FOR MEASURING ABSOLUTE ACTIVITY OF β-EMITTING MATERIALS. B. V. Karosev, V. B. Luk'yanov, Yu. A. Priselkov, and Wen-tsui Wan. Vestn. Mosk. Univ., Ser. II, Khim., No. 2, 24-7(Mar.-Apr. 1963). (In Russian)

Descriptions are given of the design and performance of a 4π counter operating with line-supply methane and technical cylinder-supplied methane. Absolute activity measurements of solutions containing radioisotopes with various β spectra (Ca^{45}, Tl^{204}, and P^{32}) showed that the accuracy of absolute activity increases with the maximum of β-emitter energy. The results of four experiments showed standard deflection for the four experiments determined with 95% accuracy was for P^{32}(E_{max} = 1.71 Mev) 4.5% and for Ca^{45}(E_{max} = 0.254 Mev) 10%. (R.V.J.)

36173 THE EFFECT OF VARIATIONS IN THE AMBIENT AIR ON THE CALIBRATION AND USE OF IONIZATION DOSIMETERS. G. P. Barnard, G. H. Aston, and A. R. S. Marsh. London, Publication of the National Physical Laboratory by Her Majesty's Stationery Office, [1962]. 2s.6d.

36174 TIME-OF-FLIGHT SPECTROMETER (Engineering Materials). (Oak Ridge National Lab., Tenn.). 6 units. (CAPE-1028)

The 350-kev time-of-flight spectrometer is a neutron detector. It was designed to be used in cross sections studies made with the 3-Mev Van de Graaff generator. Schematics for an amplifier, beam pulse pick off, discriminators, and a time-pulse converter are included. (F.E.S.)

36175 SOURCE AND MULTIPLIER MODIFICATIONS OF A TIME-OF-FLIGHT MASS SPECTROMETER TO INCREASE SENSITIVITY. W. K. Rohwedder, E. Selke, and E. D. Bitner (Northern Regional Research Lab., Peoria, Ill.). 13p. (CONF-74-17)

From 11th Annual Conference on Mass Spectrometry and Allied Topics, San Francisco, May 1963.

A time-of-flight mass spectrometer was fitted with a tightly enclosed source and operated in a continuous ionization mode to increase instrument sensitivity. A gate pulse was applied to the front end of the magnetic electron multiplier to eliminate the electrons due to the helium pulse before they reached the multiplier dynode strips. This procedure prevented saturation of the multiplier by the helium carrier gas. With the modifications described, it is now possible to identify as little as 10 mg of an unknown in a chromatogram. (P.C.H.)

36176 AN INEXPENSIVE MÖSSBAUER SPECTROMETER. R. L. Collins (Univ. of Texas, Austin). 7p. (CONF-46-17)

From American Physical Society Meeting, Washington, D. C., Apr. 1963.

A point-by-point spectrometer for investigation of the Mössbauer effect is described. A block diagram of the spectrometer and a more detailed diagram of the servo system and modulator are shown. The spectrometer described has yielded spectra of excellent quality. (A.G.W.)

36177 IMPROVEMENTS IN OR RELATING TO ARRANGEMENTS FOR DISTINGUISHING BETWEEN TWO RADIATIONS. (to Philips' Gloeilampenfabrieken). British Patent 932,536. July 31, 1963. Priority date May 10, 1961, Switzerland.

An electronic circuit for distinguishing between 2 types of radiation, specifically α particles and neutrons, is patented. The particles are detected by some means such as a scintillator and photomultiplier. The pulses from the detected particles are applied to an integrating network and an oscillatory circuit, the pulses from different types of particles having different waveforms. The envelope of the damped oscillation from the oscillatory circuit decreases with time in the same manner as the voltage from the integrating network for the particles that have the pulse of slowest decline. The voltages from the 2 networks are added, detected, and applied to an amplitude discriminator. The circuit may be used for counting neutrons with energy above 0.3 Mev, and similar arrangments may be used for distinguishing between α particles and protons or α particles and deuterons. (M.P.G.)

ISOTOPE SEPARATION

36178 THE CHROMATOGRAPHIC SEPARATION OF THE HYDROGEN ISOTOPES INCLUDING TRITIUM. James King, Jr. (California Inst. of Tech., Pasadena). J. Phys. Chem., 67: 1397(June 1963).

A gaseous mixture of hydrogen, deuterium, tritium, deuterium hydride, and tritium hydride were separated on a single chromatographic column. The column material was a mixture of 150 to 200 mesh alumina and ferric hydroxide. The column was constructed of 7-mm Pyrex glass tubing 24 ft long and coiled to fit into a dewar jar filled with liquid nitrogen. (M.C.G.)

36179 ON BF_3 THERMAL DIFFUSION UNDER PRESSURE. G. M. Panchenkov, A. V. Makarov, V. Ya. Dyachenko, and V. D. Moiseev. Vestn. Mosk. Univ., Ser. II, Khim., No. 3, 33-6(May-June 1963). (In Russian)

Four experiments were carried out with BF_3 at 900°C and 2.5 and 8 atm pressure in order to determine the variations in thermodiffusion separation of boron isotopes. (R.V.J.)

36180 GAS SEPARATION WITH THE MOLECULAR PUMP. III. SEPARATION FACTOR AND SEPARATION POTENTIAL OF A MOLECULAR PUMP WITH SIMULTANEOUS ENRICHMENT AND IMPOVERISHMENT OF THE GAS MIXTURE INTRODUCED. Otto Boettger and Hans Pingel (AEG-Forschungsinstitut, Frankfurt am Main). Z. Angew. Phys., 16: 55-8(1963). (In German)

The separation factor and separation potential were calculated for a molecular pump in which at one slit a part of the gas mixture introduced was enriched and at the second slit the other part was impoverished. Dimensions of the pump were selected so that, in the stationary state, the composition of the gas mixture introduced was not altered at the input; it is then complementary. Since the equilibrium system appearing in the calculation cannot be explicitly resolved, only numerical solutions for UF_6 in the technically interesting range were given, in opposition to both previous works. (tr-auth)

36181 IMPROVEMENTS IN METHODS AND APPARATUS FOR PRODUCING DEUTERIUM BY DISTILLATION OF HYDROGEN. Leon Stouls (to Commissariat à l'Energie Atomique). British Patent 932,178. July 24, 1963. Priority date May 2, 1960, France.

A method and apparatus for producing deuterium containing a relatively low proportion of tritium are patented. The deuterium is produced by the distillation of natural H. The final distillation column is provided with a large number of theoretical plates so that the level corresponding to the beginning of enrichment of the mixture in tritium is lower than the level corresponding to a maximum enrichment of the mixture in deuterium. Deuterium containing a very small amount of H and tritium can be withdrawn from an intermediate level of the column, and fractions rich in tritium can be withdrawn from the bottom of the column. To reduce further the proportion of tritium in the deuterium, the tritium hydride, HT, present in the final distillation column is made to undergo a catalytic reaction in a deuterium medium to transform it partly into HD and DT, which are easier to separate from deuterium than HT. (M.P.G.)

MATHEMATICS AND COMPUTERS

36182 (AFOSR-62-72) THEORY OF INVERSE MOMENTS. Zakkula Govindarajulu (Case Inst. of Tech., Cleveland). Sept. 1962. 24p. (AD-293989)

The characteristic function for inverse moments called the inverse characteristic function is defined. Liafounov's inequality for inverse moments is obtained. Various properties, in particular, the uniqueness property (also called the inversion formula) and limit and continuity properties, are studied. Illustrations are provided wherever necessary. Many results admit multivariate generalizations. Inverse order statistics are defined. Also, some applications of inverse moments are considered. (auth)

36183 (ANL-6699) PROGRAM FOR THE LOCATION OF FOURIER PEAK CENTERS. Final Report of Program 4.10.27. M. H. Mueller, Fred Clark (Argonne National Lab., Ill.), and S. H. Simonsen (Texas. Univ., Austin). July 1963. Contract W-31-109-eng-38. 33p.

The computer program MET-146, in FORTRAN, locates maxima on Fourier (or Patterson) maps from 27 surrounding points in the 3-dimensional Fourier case and from 9 points for a 2-dimensional case. Input, output, and operations are described. Results obtained with this program are compared with those from other programs and from analytical extrapolation. A test problem is also included. (D.C.W.)

36184 (AWRE-O-71/63) NDTP, AN IBM1401 PROGRAMME TO WRITE, COPY AND MODIFY NUCLEAR DATA MAGNETIC TAPES FOR USE WITH THE ALDERMASTON NUCLEAR DATA LIBRARY. R. J. Webster (United Kingdom Atomic Energy Authority. Weapons Group. Atomic Weapons Research Establishment, Aldermaston, Berks, England). Sept. 1963. 15p.

The program NDTP for an IBM 1401 permits the transcription of cross-section data from punched cards to magnetic tape and the rearrangement of data already on magnetic tape. Provisions, operation, and features of the program are discussed. (auth)

36185 (LADC-5581) A NOTE ON LEAST SQUARES ESTIMATION OF PARAMETERS WHEN FITTING A PLANE. Aaron Goldman (Los Alamos Scientific Lab., N. Mex.). [1961]. Contract [W-7405-eng-36]. 10p.

A simplified method for fitting a plane through a set of data points by the least squares technique is described along with an IBM 7090 code available for solving the problem. An example is included. (D.C.W.)

36186 OSCILLATION OF SOLUTIONS OF A NONLINEAR EQUATION. P. E. Waltman (Sandia Corp., Albuquerque, N. Mex.). SIAM (Soc. Ind. Appl. Math.) Rev., 5: 128-30 (Apr. 1963). (SCR-650)

A criterion for the oscillation of all solutions of $y'' + a(t)f(y) = 0$ is established. It is shown that if $a'(t) > 0$ and $a(t) > 0$ for sufficiently large t, and if $f(y)$ satisfies the conditions: $f(0) = 0$; $f(y) \pm 0$, $y \pm 0$; and $f'(y)$ is continuous and non-negative, then all solutions of the equation are bounded and oscillatory. (M.P.G.)

36187 MATHEMATICAL MODELS IN PHYSICAL SCIENCES. Proceedings of the Conference at the University of Notre Dame, 1962. Stefan Drobot and Paul A. Viebrock, eds. Englewood Cliffs, N. J., Prentice-Hall, Inc., 1963. 198p. $3.75.

Mathematical models are presented as an instrument for developing interdisciplinary research among physicists, chemists, and mathematicians. Papers are included on microscopic vs macroscopic models, asymtotology, models of total ignorance in quantum mechanics, mathematical structure of the Bardeen-Cooper-Schrieffer model, properties of nonlinear transformations, phenomena associated with oscillations of a nonlinear model string, stochastic approach to cosmology, and constraints in classical fields. Abstracts of papers on the problem of the gas of hard spheres, physical models in mathematics, and mathematical models in statistical mechanics were also presented. (C.E.S.)

METALS, CERAMICS, AND OTHER MATERIALS

General and Miscellaneous

Refer also to abstracts 35264, 35265, 35772, 36370, 36464, and 36989.

36188 (AD-289857) DESIGN DATA STUDY FOR COATED COLUMBIUM ALLOYS. Bimonthly Technical Progress Report No. 5, August 21, 1962 through October 21, 1962. J. D. Gadd (TAPCO. Div. of Thompson Ramo Wooldridge Inc., Cleveland). Nov. 21, 1962. Contract NOw 52-0098-c. 38p. (TM-3544-67)

The design data study of Pfaudler and TRW protective coated 30 mil Fansteel 85 alloy sheet is in progress. Specimen designs and preparation, coating application techniques and evaluation test procedures are presented. Cyclic oxidation tests in air at 1600 to 2600°F were conducted. Tensile properties of FS-85 alloy sheet were determined uncoated in vacuum and coated in air from room temperature to 2600°F. Tentative results are reported of the prestrain tolerance of the two coatings on FS-85 alloy sheet at various temperatures and the resultant effect on oxidation protection at 1600 and 2600°F. Stress rupture properties of coated FS-85 alloy are being determined in air at temperatures from 1600 to 2600°F and tentative results are presented. (auth)

36189 (ASD-TR-7-772(VI)) DEVELOPMENT OF MANUFACTURING PROCESS FOR HIGH PURITY ELECTRONIC CERAMICS. Interim Technical Progress Report, June 1, 1962–August 31, 1962. J. H. Battle, A. J. Marino, Jr., and E. W. Currier (ITT Federal Labs. Div. of International Telephone and Telegraph Corp., Nutley, N. J.). Sept. 1962. Contract AF33(600)-42473. 14p. (AD-287012)

The purpose of this project is to develop new or improved manufacturing methods for large scale production of ferroelectric or piezoelectric ceramic materials such as titanates, zirconates, niobates, and tantalates. A major requirement is high purity (99.95%). The accomplishments include the operation of a pilot plant, the chemical and x-ray analyses of its product, and the ceramic processing of the powders. The synthesis of $BaTiO_3$ in the pilot plant was a successful scale-up of the bench scale runs. Product analysis shows it to be within allowable impurity tolerances and is stoichiometric within analytical detection limits. (auth)

36190 (ASD-TDR-62-509(Vol.I)) BERYLLIUM RESEARCH AND DEVELOPMENT PROGRAM. S. H. Gelles (Nuclear Metals, Inc., Concord, Mass.). May 1962. Contract AF33(616)-7065. 214p. (AD-290493)

Effort was directed to making Be more useful as a structural material. Work in the field of purification, joining, flow, and fracture is described. The preparation of high purity Be by the decomposition of Be_{12}, the joining of Be by ultrasonic welding, and the resistance spot welding of Be are described. Also, a study of the distribution of BeO and voids in Be by replication electron microscopy, an investigation of the brittle behavior of Be by transmission electron microscopy, and a study of surface damage in Be are described. (auth)

36191 (BM-RI-6285) USE OF DEPLETED URANIUM FOR CATHODIC PROTECTION. F. W. Hoertel (Bureau of Mines. Rolla Metallurgy Research Center, Mo.). Sept. 1962. 15p.

An investigation was made of the use of depleted uranium as a sacrificial anode for the cathodic protection of submerged and underground structures of iron, steel, and copper. Uranium-metal couples were tested in simulated marine environments of varying oxygen contents at pH values between 5.5 and 8.5 and under simulated boiler service condition in Rolla, Mo., city water. Similar couples were tested in samples of Missouri soils to simulate underground service. Uranium remained anodic to iron, steel, and copper in the simulated marine environments and under simulated boiler service if the electrolyte was oxygen-free city water. Uranium appeared to offer limited protection to iron, low-carbon steel, stainless steel, copper, and zinc in the simulated underground tests. Uranium anodes offer a space advantage because 1 cubic inch of uranium gives approximately the same protection as 2 cubic inches of magnesium or 1.5 cubic inches of zinc. (auth)

36192 (BNL-814) HIGH-TEMPERATURE LIQUID-METAL TECHNOLOGY REVIEW. A Bimonthly Technical Progress Review. Volume 1, Number 3. O. E. Dwyer, ed. (Brookhaven National Lab., Upton, N. Y.). June 1963. Contract AT-30-2-GEN-16. 46p. (BNL-PR-3)

Individual summaries are presented for 23 reports, mostly of the progress report type. Tables and graphs are given for the compressibility and vapor pressure of potassium, stress-rupture properties of AS-55 Nb alloy sheet and of D-43 sheet, a blowdown test in a boiler, and heat transfer to NaK flowing through a rod bundle. (D.L.C.)

36193 (GEAP-3771-9) HIGH PERFORMANCE UO_2 PROGRAM. Quarterly Progress Report No. 9, April–June 1963. B. Weidenbaum (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.). July 15, 1963. Work Performed under United States–Euratom Joint Research and Development Program. Contract AT(04-3)-189. 85p.

The operations, modifications, improvements, and neutron-flux-distribution measurements in the Pressurized Water Loop of the General Electric Test Reactor are summarized. Measurements of fission-gas pressures over UO_2 fuel rods, radiation effects on thermal conductivity of UO_2, heat treatment effects on UO_2 grain growth and melting, and performance of UO_2 fuels are carried out. (T.F.H.)

36194 (GEMP-25A) HIGH-TEMPERATURE MATERIALS PROGRAM PROGRESS REPORT NO. 25, PART A. (General Electric Co. Advanced Technology Services, Cincinnati). July 31, 1963. Contract AT(40-1)-2844. 38p.

A summary is presented of research on: fabrication of high-temperature reactor materials; and effects of radiation on high-temperature alloys. (T.F.H.)

36195 (HW-76301) CERAMICS RESEARCH AND DEVELOPMENT OPERATION QUARTERLY REPORT, JANUARY–MARCH 1963. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Contract AT(45-1)-1350. 129p.

Progress is reported on ceramics research, fuels development, and fuels testing and analysis. Separate abstracts were prepared for each of the three topics. (M.C.G.)

36196 (HW-76301(Paper 1)) CERAMICS RESEARCH (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). 44p.

Analysis of x-ray diffraction data of a 48.2 at. % C–Pu alloy indicated the possible growing-in of the zeta phase while standing at room temperature for a period of 400 days. Electrical resistivity measurements of two PuC compositions (37.2 and 39.1 at. % C) showed a nonisothermal reaction between 500 and 550°C. PuN decomposed during arc melting under one atmosphere of nitrogen to form PuN dendrites in a matrix of alpha plutonium. A combustion, gravimetric method for determining carbon in plutonium carbides was reduced to routine practice in glove boxes with a precision near 1% for samples weighing between 200 to 1000 mg and with carbon contents between 1 to 5 wt %. PuN and UN were found to form solid solutions in all proportions. X-ray powder pattern studies indicated that the region between $PuO_{1.0}$ and $PuO_{1.5}$ in the Pu–O phase diagram is a two-phase field of PuO and β-Pu_2O_3. The synthesis of plutonium suboxides by carbon reduction of PuO_2 was studied. An increase in the lattice parameters of several oxide and carbide compounds of plutonium was observed during the course of standing at room temperature. The rates of expansion ranged from 0.085×10^{-3} to 1.16×10^{-3} ($\Delta a/a_0$) per 100 days. Arc melting of PuO_2 pellets in argon, followed by air oxidation at 800°C produced >99% TD material with an O/Pu ratio of 2.00. PuO_2–MgO mixtures appeared to form a simple binary eutectic system. A method was developed for preparation of UOS by electrodeposition from a molten salt solution. The UOS decomposed above its melting point (1900 ± 50°C) into two other phases. Significant changes in the microhardness and lattice dimensions of US occurred after a low neutron exposure. Crystallite growth in UO_2–50 wt % W cermets was studied in the electron microscope by cine micrography. UO_2–W cermets were replicated with an alpha sensitive emulsion. The autoradiographs were examined by transmission electron microscopy. Rapid oxidation of UN in a UN–50 wt % W cermet was observed during controlled reaction in the electron microscope. Thin sections of UO_2 crystals were prepared for electron microscopy. UO_2 single crystals and UO_2 cermets for basic studies were prepared. A 50 pound lot of high purity arc-fused UO_2 was prepared, characterized and sent to Savannah River Laboratory for testing in the HWCTR. The monometric measurement of evolved H_2, produced by reaction of HCl with uranium, was used to analyze for free uranium metal in UO_2. Radial flow thermal conductivity measurements of UO_2 single crystals relative to polycrystals are in progress. Preliminary results indicated a substantial increase in single crystal conductivity above 1600°C that may result from radiant transfer. Metallic inclusions of uranium, which may significantly affect the physical properties of UO_2, are formed in UO_2 fuel elements irradiated with central temperatures high enough to produce extensive columnar grain growth. Improved autoradiographs of irradiated UO_2 fuel rods show that only a portion of the columnar grain region is depleted of fission products and that a high concentration of fission products is located just outside the depleted band. A lightly irradiated sample of polycrystalline UO_2 retained 83 at. % of the total fission products and 95% of total radioactivity during explosive melting. UO_2 microcores, useful in fundamental studies, were extracted from several types of UO_2 by use of ultrasonic drilling techniques. A computer program in FORTRAN language for use in calculating the interplanar spacings of crystals from their line positions on x-ray powder pattern films was written and made operational. Additional evidence supported the hypothesis that the radial limit of melting in irradiated ceramic fuels corresponds to the radial limit of subgrain structure. The heat transfer rate through molten UO_2 was estimated to be 0.05 watts/cm C. (auth)

36197 (HW-76301(Paper 2)) FUELS DEVELOPMENT. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). 34p.

Direct pneumatic impaction of UO_2 to 99% TD with punches of conventional design made of tool steel, rather than tungsten carbide, was accomplished for the first time. Improved mechanical strength and uniform microstructure were produced in UO_2 impacted from pulverized sintered scrap (approximately –48 mesh) by roasting the powder to an O/U ratio of 2.01 before impaction. Solid cermet disks, approximately one inch thick and four inches in diameter, were fabricated by pneumatic impaction. A UO_2–W cermet was formed by pneumatic impaction of tungsten coated, –65 +200 mesh UO_2 particles. A UN–35 vol % Mo cermet was pneumatically impacted at 1250°C and 225,000 psi to a density of 12.49 g/cm^3 (97% TD). A US–50 vol % W cermet with a continuous tungsten matrix was compacted by pneumatic impaction at 1200°C to a density of 13.63 g/cm^3 (98% TD). Tool size was increased to make possible the pneumatic impaction of 3.5 pounds of UO_2–PuO_2 at one time. Uniform plutonium distribution was found in UO_2–2.5 wt % PuO_2, and in UO_2–1.3 wt % PuO_2, formed by pneumatic impaction at 145,000 psi and 1200°C. A technique for the encapsulation of cermets simultaneously with pneumatic impaction was developed. Simulated fission product oxides were pneumatically impacted in both 2.5 and 4 inch diameter containers. A manipulator system, consisting of two boom-crane mounted manipulators was installed in the remote fuel element fabrication enclosure. A water tank was installed on one side of the remote fabrication facility for experimental fuel element refurbishing studies. The rejuvenation fuel element (GEH-4-81) was successfully irradiated for one cycle in the MTR at the National Reactor Testing Station and was returned to Hanford for reenrichment. Tungsten was bonded without the formation of the large recrystallization grains that normally appear in the weld zone. Successful joining of pneumatically impacted UO_2–50 wt % W cermet material was achieved. Particle size distribution for vibrational compaction of a 1$^3/_8$-inch OD × $^1/_4$-inch ID annular fuel capsule was calculated from a mathematical model developed. This distribution gave a 93% theoretical density. A pilot fabrication run of 50 swaged PRTR fuel clusters was essentially completed. Design of the vibration compaction facility for the EBWR plutonium fuel loading was approved. A uniform physical mixture of UO_2–PuO_2 in a fuel rod can be achieved by physically mixing the core material for each rod in an individual container. A gamma-scanning, nondestructive test was developed to obtain both qualitative and quantitative data on the distribution of plutonium in fuel rods. Fuel elements free of external contamination were made from a long coextruded rod of Al–Pu cut into short pieces using machining techniques developed to eliminate contamination at the cut ends. Six UO_2 thermocouple capsules, 18 eight-foot UO_2–PuO_2 pellet rods, and 550 three-foot Al–Pu rods were made for various special tests. (auth)

36198 (HW-76301(Paper 3)) FUELS TESTING AND ANALYSIS. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). 28p.

The general appearance of eight carefully inspected irradiated PRTR fuel elements was good and no serious

cladding defects were observed. Local high fuel temperatures in a swaged, incrementally loaded, UO_2-PuO_2 PRTR fuel rod were sufficient to cause center void formation and columnar grain growth. Only minor fuel washout and contamination release occurred following the failure of a vibrationally compacted, UO_2-PuO_2 fuel element in the PRTR. The cause of the failure was not determined. Preliminary gas release data from PRTR tubular fuel element (No. 1501) indicated that less than 10% of the fission gases and less than 50% of the sorbed gases were released during irradiation. Process tube wear was reduced by increasing the contact surface area of irradiated PRTR fuel elements. Irradiation tests of prototypic, vibrationally compacted, EBWR, UO_2-PuO_2 fuel rods were initiated. Migration of fission products and/or PuO_2 occurred during irradiation at high fuel temperatures in both $MgO-PuO_2$ and ZrO_2-PuO_2 fuel pellets. Autoradiographs showing marked plutonium and/or fission product migration aided microsampling of irradiated UO_2-PuO_2 pellets. A six-fold difference in specific gamma activity was found in samples removed from the same pellet. Capsules containing pneumatically impacted UO_2-PuO_2 (0.505 inch diameter fuel) were irradiated at a surface heat flux of approximately 900,000 Btu/(hr)(sq ft). The thermal conductivity of large grain (single and bicrystal) UO_2 was apparently greater than that of small grain UO_2 during irradiation. UO_2-W cermets were chemically and dimensionally stable during irradiation for 2 hours with a surface temperature greater than 2100°C. The gross reactivity of an Al–Pu fueled test capsule made of high exposure (27.17% Pu^{240}) plutonium was 38% greater than that of a similar capsule incorporating low exposure (6.25% Pu^{240}) plutonium after irradiation to 1.2×10^{20} fissions/cc (92% burnup of original fissionable atoms). ThO_2-PuO_2 irradiation test pellets (95 to 96% TD) containing 2 to 5 wt % PuO_2 were made by dry pressing calcined powder mixtures and sintering in hydrogen at 1600°C for 6 hours. No bonding of fuel particles was observed in cold-swaged UO_2 heated out-of-reactor for more than 1000 hours at 550°C confirming the hypothesis that sintering observed in PRTR fuel rods is an irradiation effect. Flux monitor measurements showed that four capsules previously described generated rod powers between 18.3 and 23.7 kw/ft. Problems associated with postirradiation examination of low exposure plutonium fuels are discussed. (auth)

36199 (IDO-16870) USE OF "BINAL" IN REACTOR CONTROL RODS. R. E. Heffner (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). June 20, 1963. Contract AT(10-1)-205. 40p.

Tests were made on Binal, a B–Al alloy made by a wrought powdered metallurgical technique, to evaluate its use in reactor control rods. Microstructure, tensile tests, corrosion tests, and weld tests indicated that Binal had good properties for reactor use. The mechanical properties of Binal are listed. A comparison is made of the reactivity worths of Binal and of Cd. Binal was selected as the control material in both Spert I and IV, and some operational experience with Binal control rods is described. (D.L.C.)

36200 (NP-13033) MERCURY CORROSION LOOP TESTING PROGRAM. Report No. 0584 (Final). (Aerojet-General Corp., Azusa, Calif.). Aug. 1963. Contract NAS 3-1925. 67p.

The Mercury Corrosion Loop Testing Program conducted to support materials evaluation for the SNAP-8 system program is described. Niobium and 9Cr–1Mo steel alloy tubing clad with stainless steel were obtained and evaluated to determine their suitability as backup materials for Haynes 25. The test program showed that a boiling mercury loop, constructed of Haynes 25 and operated near the conditions expected in SNAP-8, could generate corrosion products that are carried over in the mercury vapor and deposited in such components as the nozzles in the turbine simulator. The clad tubing concept for the materials problem in a NaK-to-mercury type boiler appeared to warrant further consideration for application in the SNAP-8 system. (auth)

36201 (NP-13043) DEFENSE METALS INFORMATION CENTER SELECTED ACCESSIONS. Patricia B. Plate, Comp. (Battelle Memorial Inst. Defense Metals Information Center, Columbus, Ohio). July 1963. Contract AF33(616)-7747. 85p.

A bibliography of 133 references in abstracted form is presented on metals, alloys, and refractory materials. The references are arranged according to high-strength alloys, light metals, nonmetallics, refractory metals, and miscellaneous (coatings, applications, and composites). Author and subject indexes are included. (D.L.C.)

36202 (SCC-13) EXPLORATION OF THE EFFECTS OF SOME CHEMICAL ADDITIVES ON GRAPHITE DENSITY AND RADIATION CONTRACTION. Final Report, December 1, 1960–December 1, 1961. W. E. Parker and R. W. Marek (Speer Carbon Co. Research Lab., Niagara Falls, N. Y.). For General Electric Co. Hanford Atomic Products Operation, Richland, Wash. Contract AT(45-1)-1350, Subcontract DDR-118. 24p.

Seventeen experimental sample sets were prepared using a series of chemical additives. A standard set containing no additive was also prepared. For samples in which 1 wt % of the chemical additive was used, Ni_2O_3 addition produced the greatest increase in density, followed closely by Fe_2O_3(std.), $CrCl_3 \cdot 6H_2O$, and V_2O_3. A further increase in density was observed for the use of 2 to 4 wt % of Fe_2O_3 (std.). The addition of 1 wt % of purified Fe_2O_3 did not yield a densification effect equivalent to that produced by the same addition of a technical grade of Fe_2O_3. Greatest volume shrinkage was observed when Fe_2O_3(std.) was the additive employed. Similar, although not of equivalent magnitude, results were obtained for the systems containing Cr, V, and Ni compounds. (auth)

36203 (TID-3572) METALLURGY OF MOLYBDENUM, NIOBIUM, AND MOLYBDENUM–NIOBIUM ALLOYS. A Literature Search. (Division of Technical Information Extension, AEC; American Society for Metals, Metals Park, Ohio; Armed Services Technical Information Agency, Arlington, Va.; and General Electric Co. Flight Propulsion Lab. Dept., Cincinnati). Apr. 1963. 118p.

A total of 1910 references are presented on the extractive metallurgy, refining and purification of the base metals, fabrication methods, physical properties, and corrosion behavior of Mo, Nb, and Mo–Nb alloys. The approximate dates of coverage are from Jan. 1957 to Sept. 1962. Author, subject, and report number indexes are included. (D.L.C.)

36204 (TID-17847) PROPERTIES, HANDLING PROCEDURES, AND APPLICATIONS OF MERCURY–THALLIUM EUTECTIC ALLOY. J. T. Boag (Minneapolis-Honeywell Regulator Co. Heiland Div., Denver). Jan. 1963. For Sandia Corp., Albuquerque, N. Mex. Contract AT(29-1)-789. 18p. (SCDC-3008)

A description is given of the basic properties, applications, handling procedures, and safety considerations of the eutectic alloy of mercury and thallium. The alloy freezes at −74°F, while mercury freezes at −39°F; the alloy can be

used in devices required to operate at −65°F, while pure mercury cannot be used in such applications. (auth)

36205 (TID-17858) PHYSICAL AND ELECTRICAL PROPERTIES OF HOT-PRESSED CERAMICS. Gene H. Haertling (Sandia Corp., Albuquerque, N. Mex.). Jan. 1963. Contract AT(29-1)-789. 31p. (SCDC-2951)

An experimental procedure was developed to hot-press ceramic compositions under a wide range of temperature, time and pressure conditions. A typical member of the lead zirconate-lead titanate-lead stannate family developed by Clevite Corporation was chosen for the experiment, so that the effects of hot-pressing could be observed on ferroelectric properties as well as on other common physical properties of ceramics. Temperature was varied from 1050 to 1400°C, time (at temperature) from one minute to twelve hours, and pressure from 1500 to 12,000 psi. Significant improvements in properties were noted for the hot-pressed specimens in comparison to the normally sintered material. Selection of the proper hot-pressing conditions resulted in a general improvement of all the commonly investigated ceramic properties, such as increased remanent polarization, squareness ratio (P_r/P_s), planar coupling coefficient and translucency, and a decreased coercive field. Dielectric constant, tangent δ, and thermal expansion remained unchanged by hot-pressing. A study of the specimen microstructures showed that the final grain size could be varied by alteration of the hot-pressing conditions or by addition of small amounts of foreign ions to the base composition. Results indicated a dependence of remanent polarization on average grain size. Bulk densities as high as 99.75% theoretical were obtained by hot-pressing. (auth)

36206 (UCRL-10712) STACKING FAULT ENERGY, ORDERING AND TRANSGRANULAR STRESS CORROSION CRACKING IN AUSTENITIC ALLOYS. D. L. Douglass (General Electric Co. Vallecitos Atomic Lab., Pleasanton, Calif.); G. Thomas, and W. R. Roser (California. Univ., Berkeley. Lawrence Radiation Lab.). Mar. 1963. Contract W-7405-eng-48. 48p. (CONF-28-4)

From 2nd International Congress on Metallic Corrosion, New York, Mar. 1963.

Electron microscopy was employed to investigate the structures of various fcc solid solutions, particularly austenitic alloys, which are susceptible and non-susceptible to transgranular stress corrosion cracking. It was found that susceptibility is associated with those alloys in which the dislocations move in coplanar groups with little or no cross-slip either as a result of low stacking fault energy and/or short-range order. It is proposed that destruction of strong short-range order by plastic deformation in the slip planes is responsible for localized chemical attack and transgranular failure during stress corrosion. Coplanar groups of dislocations alone may not be responsible for the phenomenon; for example, nichrome does not crack even though the dislocations exist in coplanar arrays due to its low stacking fault energy. The model also predicts the change from intercrystalline to transcrystalline embrittlement observed in α-brass and the lack of susceptibility of random solid solutions. In pure metals and alloys where easy cross-slip and dislocation tangling occurs no transgranular susceptibility is found. Results are given for stacking fault energies, γ, in numerous austenitic alloys. It is further shown that certain alloying additions, e.g., Cr, Nb, and Ti in solid solution appreciably decrease γ so that dislocations are always coplanar. Nitrogen does not appear to change γ but is also responsible for promoting coplanar dislocation arrays, probably by increasing the tendency for short-range order. (auth)

36207 THE PREPARATION OF A HAFNIUM-FREE MAGNESIUM–ZIRCONIUM ALLOY BY PROCESS SEPARATION OF HAFNIUM. H. A. Timm, A. Froats, and H. G. Warrington (Dominion Magnesium Ltd., Haley Station, Ont.). Can. Met. Quart., 2: 317-24(July-Sept. 1963).

Magnesium–zirconium alloy for sheathing uranium elements in gas-cooled reactors was successfully prepared from high-purity magnesium, and zirconium produced by the magnesium reduction of a crude oxide. Hafnium separation, suggested by a higher ratio Hf to Zr in the sludge than in the melt was considered possible owing to its higher density and melting point and its isomorphous behavior to the strongly electropositive zirconium which readily forms compounds and exhibits a two-phase melt when added in excess of 0.5%. Precipitation of excess zirconium by settling was aided by the development of a flux of high density and low inclusion-flux interfacial energy. Removal of hafnium and other high neutron-capture cross-section impurities was achieved. (auth)

36208 CHEMICAL SYNTHESIS VIA THE HIGH INTENSITY ARC PROCESS. J. O. Gibson and R. Weidman (Vitro Labs., West Orange, N. J.). Chem. Eng. Progr., 59: No. 9, 53-6(Sept. 1963).

A review is presented on the production of high purity refractory carbides and metals at temperatures of 2000 to 7000°K using consumable homogeneous electrodes in the high intensity arc process. The fabrication of Al, C–U–Zr, uranium carbides, and tantalum carbides is discussed. (P.C.H.)

36209 RADIOISOTOPES IN METALLURGY. D. H. Houseman. Steel Coal, 186: 896-902(May 10, 1963).

The availability, properties, and detection of radioisotopes with applications in ferrous metallurgy are discussed. The use of isotopes in radioactivation analysis to determine oxygen content in steel is also included. Consideration is given to x-ray fluorescence and tracer techniques in relation to steelmaking and for investigating non-metallic inclusions in steel. (Rev. Metal Lit., 20: No. 8, Aug. 1963)

36210 STUDY OF THE PURIFICATION OF ALUMINUM BY THE METHOD OF ZONE MELTING AND NEUTRON ACTIVATION ANALYSIS. Masatoshi Kobayashi, Sho Maeda, Teruko Sawai, and Hiraomi Kurosu. Tokyo Metropolitan Isotope Centre Ann. Rept., 1: 33-44(1962). (In French)

To study the mechanism of the zone-refining of aluminum, a molten zone was passed along a specimen (5mm diam × 300mm) of 99.99% purity to which was added a trace amount of antimony, samarium, iron, and scandium. The relative purification efficiency of antimony, samarium, scandium, and iron in 99.99% aluminum were about 0.2, 0.1, 0.5, and 0.1 respectively, but scandium was hardly excluded. The metallographical feature of purification of the specimens after single-pass zone-refining was observed by autoradiography. For the zone-refining operation of aluminum, two apparatuses were employed, one a high frequency induction-heated zone-refining apparatus having a molten-zone velocity of 0.6mm/min, the other an electron-bombardment floating zone-refining apparatus having a molten-zone velocity of 1.6mm/min. The distribution of each trace element in the specimen after zone-refining was determined by neutron activation analysis. The radioinduced activity of the specimens was measured with a well-type scintillation counter and γ-ray spectrometer. (auth)

36211 PREPARATION OF SCANDIUM, YTTRIUM AND GADOLINIUM MONOCRYSTALS. E. M. Savitskii, V. F. Terekhova, O. P. Naumkin, and I. V. Burov. Tsvetn. Metal., No. 5, 51-3(May 1963). (In Russian)

Production of Sc, Y, and Gd monocrystals by recrystallization annealing of distilled metal is described. An analysis of prepared 12 × 8 × 6 mm Sc crystals showed that microhardness at the base is 200 to 210 kg/mm^2, exceeding by a factor of 2 the microhardness at the plane of the prism. (R.V.J.)

36212 WERKSTOFFE DER KERNTECHNIK. TEIL IV. (Materials for Nuclear Technology. Part IV). Oskar Hauser, F. Wolfgang Krueger, and Wolfgang Schimmel. Berlin, VEB Deutscher Verlag der Wissenschaften, 1963. 156p. DM 35.

Three aspects of the subject of materials for nuclear technology are considered in Part IV – shielding materials, use of plastics in the construction of nuclear installations, and a theoretical discussion of the effect of radiation on solids. Individual abstracts have been prepared for these three sections. (J.S.R.)

36213 MATERIALS FOR SHIELDING OF RADIOACTIVE RADIATION. F. Wolfgang Krueger. p.3-69 of "Werkstoffe der Kerntechnik. Teil IV." Berlin, VEB Deutscher Verlag der Wissenschaften, 1963.

In the construction of reactors or other nuclear installations, extensive biological and technical shielding precautions are necessary to prevent harm to the personnel and to insure proper functions of the devices and their maintenance and upkeep. The attenuation of gamma, neutron, beta, and alpha radiation is described. The use of concrete, metals, and hydrogen-rich materials for shielding is then considered. Glass and liquids provide transparent shielding necessary in some cases. Combinations of materials for specific shielding purposes are also described. 132 references. (J.S.R.)

36214 USE OF PLASTICS IN NUCLEAR TECHNOLOGY ESTABLISHMENTS. Wolfgang Schimmel. p.73-94 of "Werkstoffe der Kerntechnik. Teil IV." Berlin, VEB Deutscher Verlag der Wissenschaften, 1963.

The introduction of plastics into the construction of nuclear installations is described. The types of plastics used are polymerization products, polycondensation products, rubber, and elastic gum materials. The specific properties and uses of each are discussed. 99 references. (J.S.R.)

36215 THE EFFECTS OF RADIATION ON SOLIDS. Oskar Hauser. p.97-141 of "Werkstoffe der Kerntechnik. Teil IV." Berlin, VEB Deutscher Verlag der Wissenschaften, 1963.

The effects of radiation on solids are discussed. The topics considered are the interaction of radiation and solids, calculation of the number of radiation defects produced, other defects produced by elastic energy transfer, modification of the properties of irradiated materials, and annealing of radiation effects. 138 references. (J.S.R.)

36216 PROCESS FOR TREATING ZIRCONIUM ALLOYS. (to European Atomic Energy Community (EURATOM)). British Patent 932,336. July 24, 1963. Priority date Mar. 23, 1961, Germany.

A process for treating workpieces of Zr alloys to improve resistance to corrosion by steam and by water at high pressure and temperature is patented. The alloys contain from 0.5 to 5% of Nb, 3% or less of Sn, and 0.5% or less each, and in toto 2% or less, of Fe, Ni, Cr, Ta, Pd, Mo, and W. The workpiece is cold shaped and is then given heat treatment at temperatures from 550 to 590°C. Before being cold shaped, the workpiece may be given conventional annealing or hot shaping at temperatures from 640 to 1000°C. The workpiece may be given a number of cold shaping treatments, with or without intermediate heat treatments, and the heat treatment may be given before or after the final cold shaping. (M.P.G.)

36217 CARBON ARTICLES. Robert Lewis Bickerdike, Anthony Reginald George Brown, William Johnson, and William Watt (to United Kingdom Atomic Energy Authority). British Patent 932,387. July 24, 1963. Filed Jan. 22, 1959.

A process for treating a porous carbon article is patented. The process increases the density of the article and may be used to treat some graphites with relatively large pores without the danger of the article bursting during the carbonizing process. The article is impregnated with furfuryl alcohol or with a mixture of furfuryl alcohol and a suspension of a finely divided carbon. The impregnant is hardened in the pores and then carbonized under nonoxidizing conditions. The article is then heated in a moving stream of a gaseous or vaporous carbon compound at a steady temperature between 500 and 1500°C. Temperature, pressure, and flow rate are carefully controlled to prevent the deposition of soot on the surface. (M.P.G.)

36218 TUNGSTEN – NIOBIUM – TITANIUM ALLOYS. (to E. I. du Pont de Nemours and Co.). British Patent 932,981. July 31, 1963. Priority date Oct. 11, 1960, United States.

The composition of ternary alloys resistant to oxidation at high temperatures and processes for the production of the alloys are patented. Two compositional areas in the ternary alloy system show greatly improved oxidation resistance. The first area includes alloys comprising by weight 75 to 95% W, 4.8 to 24.8% Nb, and 0.2 to 12.5% Ti. The second area includes alloys of 42 to 65% W, 17.5 to 42.5% Nb, and 7.5 to 27.5% Ti. The alloys may be prepared by arc melting the components in powdered form. (M.P.G.)

36219 ALUMINUM ALLOYS. (to Atomic Energy of Canada Ltd.). British Patent 934,544. Aug. 21, 1963. Priority date Apr. 19, 1961, United States.

An Al – Pu alloy containing from 2 to 8 wt. % Pu is patented. The alloy is a ternary alloy with the third element being Ni, Si, or U. The percentage of Ni should be from 1 to 2 wt. %, and that of Si or U should be from 13 to 17 wt. %, with the balance Al. The alloy is prepared by preparing a binary alloy of Al and Pu and adding Ni, Si, or U to it while it is molten. The alloy is corrosion-resistant, does not absorb neutrons to a significant degree, and is suitable for reactor fuel elements. (M.P.G.)

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Refer also to abstract 36873.

36220 (AD-287255) LIQUID METAL EMBRITTLEMENT OF A Cu – 2% Be ALLOY. Report R-1652. James V. Rinnovatore (Frankford Arsenal. Pittman-Dunn Lab., Philadelphia). Aug. 1962. 14p.

The propensity toward brittle fracture of a Cu – 2% Be alloy in the presence of a 2% Na amalgam was investigated. Tensile properties of the alloy in the dry and wetted conditions were determined as a function of the following thermal-mechanical histories: solution treated and aged at 700°F; solution treated plus maximum cold rolled and aged at 700°F; solution treated, aged at 700°F for 1 hr, and cold worked; solution treated, aged at 700°F for 9 hr, and cold worked; solution treated and aged at 400°F; solution treated and cold worked. The results obtained from the conditions listed above showed that wetted fracture behavior was more affected by the manner in which the alloy was treated to obtain a particular strength than by the actual

magnitude of the strength. The results are consistent with the recent findings in work with Al alloys, whereby fracture strength in a liquid metal environment was correlated with thermal-mechanical history. (auth)

36221 (BMI-1636) DEVELOPMENT OF NIOBIUM-BASE ALLOYS FOR USE IN A NUCLEAR SUPERHEATER. John A. DeMastry, Warren E. Berry, Arthur A. Bauer, and Frank A. Rough (Battelle Memorial Inst., Columbus, Ohio). June 27, 1963. Work Performed under United States–Euratom Joint Research and Development Program. Contract W-7405-eng-92. 42p. (EURAEC-744)

Niobium-base alloys containing additions of aluminum, chromium, iron, molybdenum, titanium, vanadium, and zirconium were prepared by arc melting and evaluated for corrosion resistance in the cold-worked (90 per cent reduction) and annealed (1 hr at 1200°C) conditions by autoclave tests in 1500-psi steam at 540°C. Additions of aluminum, iron, molybdenum, and zirconium were detrimental, in the amounts studied, to corrosion resistance while chromium, titanium, and vanadium were beneficial. In addition, the alloys generally showed better resistance to steam corrosion when tested in the cold-worked condition. A family of alloys containing additions of 18 to 24 at. % titanium, 12 to 18 at. % vanadium, and 9 to 12 at. % chromium to niobium exhibited good resistance to 540°C steam. A corrosion feature unique to this family of alloys was the formation of an adherent shiny, bluish-black oxide film. In 189 days of exposure to 540°C steam, specimens of one of the alloys, niobium-21 at. % titanium-12 at. % vanadium-9 at. % chromium, underwent a weight gain of 227 mg per dm^2. (auth)

36222 (BMI-X-253) CORROSION RESISTANCE OF NICKEL-BASE ALLOYS IN A NaF–LiF–BeF_2–ZrF_4 MIXTURE UNDER HYDROFLUORINATOR CONDITIONS AT 500 C, WITH AND WITHOUT ZIRCALOY-2 DISSOLVING. PART II. P. D. Miller, E. F. Stephan, W. K. Boyd, W. N. Stiegelmeyer, and F. W. Fink (Battelle Memorial Inst., Columbus, Ohio). Aug. 23, 1963. Contract [W-7405-eng-92]. 23p.

The dissolution rate of Zircaloy-2 in a salt mixture of initial composition 25 mole % LiF–37 mole % NaF–8.5 mole % BeF_2–29 mole % ZrF_4 was measured at 500°C under hydrofluorinator conditions. The corrosion of INOR-8, HyMu-80, Alloy 2 (85Ni–10Mo–5Fe), 95Ni–5Fe, 99Ni–1Al, and INCO-61 by this salt under the same conditions, with and without Zircaloy-2 dissolution, was also studied. The results show that INOR-8, HyMu-80, or Alloy 2 could be used as construction materials, while the other alloys are considerably less resistant. Corrosion is reduced in the presence of dissolving Zircaloy, except for 95Ni–5Fe. (D.L.C.)

36223 (DPST-63-71-2) APPLICATION OF THE ELECTRON MICROPROBE TO THE STUDY OF ZIRCALOY CORROSION FILMS. Quarterly Progress Report, April 1–June 1963. (Du Pont de Nemours (E. I.) & Co. Pigments Dept., Wilmington, Del.). Aug. 1963. Contract AT(07-2)-1. 17p.

Progress is reported on electron microprobe studies of the corrosion mechanisms of Zircaloy-2, to correlate the chemical constitution of the oxide films with that of the underlying alloy, and to gain an insight into the role of the alloying elements in the oxidation process. (B.O.G.)

36224 (GEMP-218) OXIDATION BEHAVIOR OF INTERMETALLIC COMPOUNDS IN THE Nb–Ti–Al SYSTEM. C. S. Wukusick (General Electric Co. Advanced Technology Services, Cincinnati). July 31, 1963. Contract AT(40-1)-2847. 21p.

The oxidation behavior of intermetallic compounds in the Nb–Ti–Al system was studied. Nb–Al compounds are subject to the low temperature (600 to 1000°C) "pest" phenomenon. Large additions of titanium inhibited this reaction by formation of titanium oxide which is protective to about 1000°C. Poor oxidation resistance at temperatures from 1000 to about 1300°C is due to the formation of a duplex oxide, $TiO_2 + Al_2O_3$, with TiO_2 as the matrix. At higher temperatures, selective oxidation of aluminum results in formation of a protective Al_2O_3 film. Chromium additions were found to increase the tendency for Al_2O_3 film formation at lower temperatures. Possible correlations between the oxidation behavior of the compounds and refractory metal coatings are discussed. (auth)

36225 (HW-76562(Rev.)) ROLE OF THE OXIDATION RATE ON THE HYDRIDING OF ZIRCONIUM ALLOYS IN GAS ATMOSPHERES CONTAINING HYDROGEN. D. W. Shannon (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Feb. 1963. Contract AT (45-1)-1350. 29p. (CONF-21-3)

From National Association of Corrosion Engineers 19th Annual Conference, New York, Mar. 1963.

Mechanism studies showed that the primary factor controlling the hydrogen absorption in zirconium alloys in gas atmospheres containing hydrogen is the rate at which oxidant (water) is transferred to the metal surface from the environment. The oxidation rate of Zircaloy-2 is shown to be pressure independent from 1500 psi to below 1 mm water pressure. When an oxidant is present, remarkable inhibition of gas phase hydriding at 400°C occurs even up to 1000 psi hydrogen pressure. However, at sufficiently low oxidant concentrations in the presence of an inert carrier gas, the oxidation rate can be reduced, due to local depletion of the oxidant. Once the oxidation rate is diffusion limited, catastrophic hydriding can occur at low hydrogen pressure (7 mm) and low temperatures (150°C), in a few days, with pre-existing autoclave films offering only transitory protection. The electrical resistance of ZrO_2 corrosion films decreased about 10^6 ohms when the atmosphere was shifted from oxidizing to non-oxidizing, probably due to an increase in the oxygen anion vacancy concentration. This suggests the initiation of gas phase hydriding may be related to a higher hydrogen diffusion rate made possible by the higher concentration of oxygen vacancies in the film. (auth)

36226 (HW-SA-2852) EVALUATION OF INHIBITORS BY POTENTIOSTATIC METHODS. Ronald D. Weed (Washington Univ., Seattle). [Dec. 17, 1962]. Contract [AT(45-1)-1350]. 33p.

A review of the anodic passivation literature was conducted. The similarity of the Pourbaix diagram to the diagrams obtained by anodic polarization is presented. The intersection of different types of cathodic polarization conditions are also presented. The theory and design of the Prazak classical potentiostat are presented. Additional changes in the test cell for controlled atmosphere and elevated temperature studies are presented. The circuit modification from manual operation to automatic operation as discussed by Hickling is presented. The postulated test procedure for evaluating inhibitors is presented. (auth)

36227 (NASA-TN-D-1739) COMPATIBILITY OF CESIUM VAPOR WITH SELECTED MATERIALS AT TEMPERATURES TO 1200°F. Joseph M. Lamberti and Neal T. Saunders (National Aeronautics and Space Administration. Lewis Research Center, Cleveland). Aug. 1963. 43p.

The test materials (refractory metals; iron-base,

nickel-base, and copper-base alloys; precious metals; light metals; and some nonmetals) were tested for 48 hours at 500, 800, and 1200°F in cesium atmospheres at pressures of approximately 0.5, 28, and 267 torr, respectively. For comparison, control samples were tested under similar conditions of time and temperature in a vacuum of approximately 10^{-6} torr. The results of metallurgical examination of the test samples are reported, and, in some cases, the mode of reaction is postulated. (auth)

36228 (ORNL-3424) CORROSION MECHANISMS IN REFRACTORY METAL–ALKALI METAL SYSTEMS. J. R. DiStefano and E. E. Hoffman (Oak Ridge National Lab., Tenn.). Sept. 16, 1963. Contract W-7405-eng-26. 55p.

The use of liquid metals introduces solid-liquid metal interactions which are not primarily electrochemical, as found in systems involving aqueous media. The corrosion of solid metals by these coolants occurs as the system attempts to attain chemical equilibrium. The mechanisms by which this can occur are (a) dissolutioning, which results from the solubility relationships between the solid and liquid metals, and (b) impurity reactions, resulting from the presence of interstitial impurities, such as oxygen, nitrogen, and carbon, in the solid and liquid metals. The manner in which dissolutioning proceeds gives rise to many types of attack ranging from simple solution to mass transfer of one or more constituents of an alloy. Some variables which influence the rate and type of dissolutive corrosion are: temperature, flow velocity, surface area to volume ratio, surface condition of solid metal, temperature gradient, and number of materials in contact with the same liquid metal. The refractory metals tungsten, molybdenum, tantalum, and niobium, as well as other high-melting body-centered cubic metals, have excellent resistance to dissolutive attack by the alkali liquid metals at high temperatures. However, there are numerous occasions when it is desirable to utilize the unique capabilities of several structural materials in the same system. A few experiments have been conducted which show that, when more than one type of solid metal or alloy is in contact with an alkali metal, the tendency for the system to achieve equilibrium results in a number of complex interactions involving interchange of metallic and nonmetallic constituents. These interactions generally are deleterious and therefore material selection can be limited. The most significant corrosion problem involving refractory metals appears to be the influence of the impurities, oxygen, nitrogen, and carbon. Experiments have been conducted to study the effect of such impurities in both the refractory metals and alkali metals. As an example, data are presented which show that the presence of small quantities of oxygen in either tantalum or niobium results in the penetration of these metals by lithium over a wide range of temperatures. It has also been found that oxygen in sodium increases its corrosion rate when in contact with niobium and other refractory metals. In addition, a method to predict the redistribution of impurities which are present in solution in either the solid or liquid metal is compared with experimental results. The corrosion of solid metals by liquid metals often occurs in complex multicomponent systems. For this reason, further data on solubilities of single components, multicomponent effects, temperature coefficients of solubilities, and kinetics of dissolution and precipitation of solid metals are needed. It is also suggested that more emphasis be placed on analytical techniques for determining the concentrations of oxygen, nitrogen, and carbon in liquid metals in order that their effects upon various corrosion processes might be better understood. (auth)

36229 (TID-17856) KINETICS OF OXIDE FILM GROWTH ON METAL CRYSTALS. II. HOMOGENEOUS FIELD APPROXIMATIONS. A. T. Fromhold, Jr. (Sandia Corp., Albuquerque, N. Mex.). Jan. 1963. Contract AT(29-1)-789. 73p. (SCDC-3017)

Homogeneous field approximations yield simple equations relating film thickness L(t) to time t of oxidation from steady-state equations. High-temperature parabolic equations have a modified rate constant k′ due to a constant potential ϕ across the film. Both k′ and ϕ increase with (concentration) x (mobility) and ratio of boundary concentrations for the electronic species and decrease for corresponding changes for the ionic species. For limited thermionic emission of one species with rate determined by diffusion of the second species, the relationship between L(t) and t is $1 + \beta t = \exp(\alpha L(t)) - \alpha L(t)$, with α and β determined from emission and diffusion parameters. The field can be essentially independent of L(t) for tunnelling from the metal crystal through the film, to traps, and between traps in the oxide. Logarithmic [$L(t) \propto \log(1 + t/t_0)$] and N^{th} root [$L(t) \propto t^{1/N}$] equations result. For maximum tunnel current less than diffusion current, rate is controlled by tunnelling or field emission in variable field. A cubic law [$L(t)^3 \propto t$], an exponential law [$L(t) \propto 1 - \exp(-\nu t)$], a logarithmic law, a modified exponential law [$L(t) \propto 1 - \exp\{-(L(t)/L(\infty)) - t/\tau\}$], and other logarithmic and exponential laws are obtained, depending on the tunnel mechanism. For space charge fields greater than 10^4 volts/cm with fixed or variable surface charge, a modified exponential law [$L(t)^2 \propto |1 - \exp(2\psi t)|$] results, with ψ determined by space charge. Both exponentially increasing and limiting thickness L(t) are possible, depending on surface and space charge. Experimental data for Cu monocrystals are reproduced between 78 and 451°K and at 1173°K. The mechanisms are linear tunneling through the film with variable field from 78 to 298°K (4Å ≤ L(t) ≤ 15Å), linear tunneling under constant field to traps in the film from 323 to 451°K (30Å ≤ L(t) ≤ 1000Å, and enhanced diffusion with no limitation by thermionic emission at 1173°K. Below 451°K, space charge is not appreciable, and the work function ϕ_M is greater than kT. Values are about 10^5 volts/cm for the constant field and about 10^7 vacancies/cm-sec (concentration) × (diffusion coefficient); both vary exponentially with temperature to give average activation energies for diffusion in the [111] and [110] directions in Cu_2O and an average value for free energy of trap formation of 0.7, 1.1, and 1.3 ev respectively. (auth)

36230 (TID-17974) A THEORY OF THE EFFECT OF HEAT FLUX AND TEMPERATURE ON THE IN-PILE CORROSION RATE OF ZIRCONIUM ALLOYS. W. Kermit Anderson (Knolls Atomic Power Lab., Schenectady, N. Y.). Jan. 19, 1963. Contract W-31-109-eng-52. 18p.

A modification of the theory of the diffusion controlled corrosion of zirconium alloys which takes account of behavior of alloys under high heat flux is proposed. Computations of isothermal rates using an over-simplified and partial representation of the theory are reported. Arguments concerning white product formation in reactor systems in which fissile material is carried in the coolant lead qualitatively to the conclusion that white oxide is not likely to form in aqueous systems operating at bulk water temperatures below 500°F. (auth)

36231 THE CORROSION RESISTANCE OF TITANIUM, ZIRCONIUM AND TANTALUM. J. P. A. Wortley. Corrosion Prevent. Control, 10: 21-6(Apr. 1963).

Corrosion testing, oxidation, reduction, polarization, and anodic passivation of Ti, Ta, and Zr is discussed. Determination was made of the polarization curve and oxidation

and corrosion resistance. Application of the metals in chemical industry is also discussed. (Rev. Metal Lit., 20: No. 7, July 1963)

36232 OBSERVATIONS ON THE OXIDATION OF BERYLLIUM IN CARBON DIOXIDE AT 600-700 DEGREES. I. A. Menzies. Corrosion Sci., 3: 35-49(Jan.-Mar. 1963).

Thin film formation, non-uniform film thickening, and localized intergranular penetration stages in the oxidation of Be sheet and extruded discs prepared from powder were investigated. (Rev. Metal Lit., 20: No. 7, July 1963)

36233 CORROSION OF CARBON STEEL BY HIGH-TEMPERATURE LIQUID MERCURY. A. H. Fleitman, A. J. Romano, and C. J. Klamut (Brookhaven National Lab., Upton, N. Y.). J. Electrochem. Soc., 110: 964-9(Sept. 1963). (BNL-6630)

All liquid Hg thermal convection loop experiments were carried out at a temperature differential of 400°F (1000 to 600°F) for 8000 hr in carbon steel systems. The effect of Ti and Zr additions in inhibiting corrosion was evaluated. Results of these experiments show that no adherent deposits were formed on the loop walls, and the presence of Zr and Ti resulted in less overall corrosion. A comparison of the amount of iron residue filtered from the loops indicated Zr is a more effective inhibitor than Ti. (auth)

36234 SOME EFFECTS OF PRESSURE ON THE OXIDATION OF ZIRCALOY-2 IN STEAM AND OXYGEN. B. Cox (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Less-Common Metals, 5: 325-36(Aug. 1963). (In English)

Experiments under constant pressure conditions showed that the oxidation of Zircaloy-2 in steam or oxygen is relatively insensitive to pressure. When the pressure is changed during the course of post-transition oxidation, however, the rate of oxidation was observed to change proportionately with the change in pressure. Subsequently the rate of oxidation recovers and eventually attains a rate close to that prior to the changing of the gas pressure. This behavior is difficult to reconcile with the concept of an oxide diffusion barrier of constant thickness that controls the linear post-transition oxidation rate. Alternative mechanisms are discussed and it was concluded that the post-transition oxidation rate at any temperature may be determined by the rate of oxidation of non-stoichiometric ZrO_2 at that temperature. The possibility of performing experiments to test the suggestions is considered. (auth)

36235 ON CATASTROPHIC OXIDATION OF Ti-Zr ALLOYS. Tadayuki Nakayama (Waseda Univ., Tokyo), Fumio Shoji, and Elichi Yagi. Nippon Kinzoku Gakkaishi, 27: 289-92(1963). (In Japanese)

The oxidation behavior of Ti-Zr alloys (ca. 5 to 90 wt %) was studied using the thermo-balance, x-ray diffraction, electron microscope, and optical microscopic methods. The catastrophic oxidation was observed in alloys containing ca. 50 ~ 90 wt % Zr oxidized in air at 700 or 900°C for 30 min or 2 hr. It was verified experimentally that β-phases (cubic type crystals) remaining in substrata were more preferentially oxidized than α-phases (hexagonal close-packed crystals) in the earliest stage of oxidation (500°C, 5 min) of the alloys showing the catastrophic oxidation at 700 or 900°C, and moreover, that these alloys showed breakaway phenomena of the surface oxide scales. The studies also clarified by x-ray diffraction and optical microscopic observations that the surfaces were mainly covered with porous TiO_2-ZrO_2 or TiO_2-ZrO_2 and ZrO_2 layers in the alloy showing the catastrophic oxidation. (auth)

36236 ON THE EFFECTS OF WELDING ON THE CORROSION RESISTANCE OF ZIRCALOY IN HIGH TEMPERATURE WATER. Goro Ito, Yoshihiko Shimizu, Tatsuya Hashimoto, Fukuhisa Matsuda, Fumino Sawayanagi, and Teiichi Terao. Trans. Natl. Res. Inst. Metals (Tokyo), 4: No. 4, 39-44(1962).

Rolled sheets 1 mm thick of Zircaloy-2 and its modified alloy were welded by different Ar shielding methods. The weld zones were corrosion tested in high-purity water at 320°C and corrosion rates, tensile strength, and elongation of the weld zones were considered as functions of time. Good corrosion resistance was found only in the specimens welded in a closed Ar-filled chamber. (Rev. Metal Lit., 20: No. 8, Aug. 1963)

36237 CHROMIC ACID ANODIZING OF BERYLLIUM: PROCESS PARAMETER. L. Whitby, E. Gowen, and D. J. Levy. p.106-8 of "48th Annual Technical Proceedings." Newark, N. J., American Electroplaters' Society, 1961.

A description is given of the apparatus used for chromic acid anodizing on Be coupons. Data are given for various coating properties including dimensional changes, coating density, and BeO formation. The corrosion afforded by the BeO coating is due to the physical barriers interposed between the base metal and the corrosive environments. (Rev. Metal Lit., 20: No. 8, Aug. 1963)

36238 CHROMIC ACID ANODIZING OF BERYLLIUM—PROCESS DEVELOPMENT. Leo Missel. p.109-11 of "48th Annual Technical Proceedings." Newark, N. J., American Electroplaters' Society, 1961.

A method for preparing a jet black glassy anodic coating or a black matte anodic coating on Be is described. The protection of the coating is a function of the metal. The effect of anodic coatings on corrosion resistance, paint adhesion, and thermal radiation was investigated. (Rev. Metal Lit., 20: No. 8, Aug. 1963)

36239 CORROSION RESISTANT ALLOY. (to United Kingdom Atomic Energy Authority). British Patent 932,574. July 31, 1963. Priority date June 23, 1953, United States.

A corrosion-resistant alloy of U, Zr, and Sn is patented. The alloy can be used in a reactor fuel element without cladding material. The alloy contains from 1 to 30% U, from 1 to 10% Sn, and the balance Zr by weight, with 10% U and 5% Sn being one recommended composition. The effects of varying the composition and methods of preparation are described. (M.P.G.)

Fabrication

36240 (AD-290604) ULTRASONIC WELDING OF REFRACTORY METALS. Progress Report No. 9, June 1 through July 31, 1962. Harold L. McKaig, Jr. (Aeroprojects, Inc., West Chester, Penna.). Nov. 16, 1962. Contract NOw 61-0410-c. 10p.

Preliminary conclusions regarding the weldability of 0.005-inch D-31 alloy foil are: new D-31 possesses good ultrasonic weldability. Crack-free welds with good tensile-shear consistency can be made. Good ultrasonic welds can be attained over a considerable power range: 850 watts with the 0.25-inch spherical sonotrode-tip radius to 1600 watts with the 0.75-inch tip radius; weld strengths consistency is good, standard deviation is low. The material is somewhat sensitive to clamping force. D-31 seems to be sensitive to tip surface condition and to surface cleanliness. Although good welds may be made with low power and low clamping force, better consistency and higher-strength levels are obtained with higher power and higher clamping force. Welding slightly below minimum clamping force yields poor results. The most suitable sonotrode-tip

radius appears to be 0.5 inch. Material quality appears to exert a paramount controlling effect on weld quality, strength level, and consistency. (auth)

36241 (BMI-1643) COATING FUEL PARTICLES WITH PYROLYTIC CARBON. Melvin F. Browning, John M. Blocher, Jr., Virginia M. Secrest, and Arthur C. Secrest (Battelle Memorial Inst., Columbus, Ohio). Aug. 16, 1963. Contract W-7405-eng-92. 71p.

Thermal dissociation of acetylene or methane in a fluidized bed of UO_2 or UC_2 particles yielded impervious coatings which show promise of fission-product retention in gas-cooled reactor applications. In coating UC_2 particles, sufficient migration of uranium occurred at temperatures above about 1500°C during the coating process to mask the results of subsequent fission-gas-release evaluations. Therefore, most of the coatings prepared for in-pile evaluation were applied at 1400°C and below. Coatings thus applied varied in structure with the coating conditions. Coating morphology, density, and the degree of preferred orientation appeared to depend upon the relative importance of heterogeneous deposition of carbon from gaseous species and the accretion of larger fragments or soot particles formed by homogeneous nucleation in the vapor phase. Periodic alteration of these conditions, such as may be induced artificially or may occur as a particle migrates through the fluidized bed, led to a lamellar appearance in the sectioned coating. Deposition at lower rates under conditions which discourage soot formation led to a columnar appearance characteristic of the pyrographites grown on extended surfaces. The proper choice of structure for nuclear applications is not yet clear, and indications exist that engineered coatings of multiple layers may be optimum. Work in this area continues. The in situ preparation of UC_2 was demonstrated by reacting the core and coating of pyrolytic-carbon-coated uranium shot. The feasibility of preparing fuel elements by infiltrating a packed bed of particles with pyrolytic carbon was tentatively established. (auth)

36242 (BRB-73) DYNAPAK EXTRUSION OF I & E FUEL ELEMENTS. PHASE III. TECHNICAL ACTIVITY. ALPHA PHASE EXTRUSION AND BETA PHASE HEAT TREATMENT IN ONE OPERATION. Q. C. Carloni and L. Lewis (Bridgeport Brass Co., Seymour, Conn.). May 14, 1963. Contract [AT(30-1)-1405]. 84p.

A series of extrusion experiments were conducted to evaluate various aspects in the DYNAPAK extrusion of I&E "0" size slugs. The prime objectives were to demonstrate the feasibility of and develop the combined alpha phase extrusion–beta phase quench technique in one operation for the Dynapak extrusion of uranium fuel elements. These objectives were fulfilled in part. Good surface quality and close dimensional tolerances were demonstrated. More development work is needed to develop a uniform structure throughout the fuel element slug length. Suitable die materials, AISI H-13 (nitrided) and straight tungsten carbide (Type H-25) were found and show somewhat superior wear resistance properties to other materials evaluated thus far. However, a long wear life mandrel material is still lacking. The extrusion of hollow billets without a mandrel appears to have no future in the present development activity, but may find use in other appropriate areas. A contained die (in liner) tooling design for the elimination of defects gave no evidence of superiority over conventional tooling employed. Bearing approach radii greater than one-quarter (¼") of an inch appear conducive to more streamline metal flow and shallow rear end defects. More work would be needed to completely substantiate these observations. Double length fuel element slugs, I&E "0" size, approximately nineteen (19) inches long were produced. Dependent upon the metal volume and the actual maximum DYNAPAK machine energy available, triple length slugs may be possible. (auth)

36243 (CONF-53-8) SOLID STATE DIFFUSION BONDING OF REFRACTORY METALS AND ALLOYS. C. O. Tarr (General Electric Co. Advanced Technology Services, Cincinnati). Aug. 8, 1962. Contract AT(40-1)-2847. 24p. (TM-62-9-8)

From 1962 World Metal Show, New York, Oct.-Nov. 1962.

Solid-state diffusion bonding of refractory metals by heating in vacuum was developed for self-bonding Cb to Cb, Mo to Mo, and bi-metal bonding Mo to Ta, etc. Other metals and alloys such as W, Re, Mo, Ta, Cb, V, W–26 Re, Mo–50 Re, and Ta–10 W have also been diffusion bonded. True metallurgical bonds are achieved at the contacting metal interfaces with only sufficient pressure to assure positioning and contact of the areas to be bonded. Grain boundary migration appears to be a major mechanism in forming the bonds. Stress-rupture tests at 4000°F on Mo and 4700°F on Ta–10 W alloy were conducted up to 10 hours in hydrogen atmosphere to permit comparison of diffusion-bonded joint rupture strength with basic thin sheet properties. (auth)

36244 (EURAEC-210) FABRICATION OF SWAGED UO_2 FUEL ELEMENTS. Quarterly Report, July 1, 1961 to September 30, 1961. (Nuklear-Chemie und-Metallurgie G.m.b.H., Wolfgang bei Hanau am Main, Germany). Oct. 31, 1961. Work Performed under United States–Euratom Joint Research and Development Program. Contract 062-61-7 RDD. 21p.

The tests to obtain inexpensive powders suitable for compacting by vibration and swaging were continued. With H_2O_2-precipitated powder (S powder), densities of up to 90% theoretical density (T.D.) could once again be reached by hot swaging. On the other hand, at 1500°C in a reducing atmosphere, post-annealed normal powder (A/T powder) could only be compacted to 87% T.D. Densities of 92% T.D. were attained with mixtures of 50% S powder and 50% powder fabricated by melting and grinding (G powder), while similar mixtures of A/T powder and G powder allowed compacting to approx. 91% T.D. With powders fabricated by uranyl nitrate decomposition no promising results were obtained, and work on these powders was therefore suspended. In swaging, the tubes were generally first of all 30% cold-reduced and then further processed at higher temperatures, preferably at 750°C. In this way, it is possible to attain considerably higher densities than simply by cold-swaging. Porosimetric tests showed that the pore diameter in the case of highly compacted G powder after 30% cold-reduction and 20% reduction at 750°C is most frequently in the order of magnitude of 10^3 Å. (auth)

36245 (EURAEC-411) STEAM SINTERING OF URANIUM DIOXIDE. Final Report, September 1960–March 1962. I. Amato and R. Colombo (FIAT. Sezione Energia Nucleare, Turin). June 30, 1962. Work Performed under United States–Euratom Joint Research and Development Program. Contract 011-60-9 RDI. 65p. (FN-E-24)

Steam sintering of UO_2 bodies is examined both on fundamental and technological grounds, and is compared with conventional hydrogen sintering and inert gas sintering of nonstoichiometric powders. Though many advantages of steam sintering are evidenced, the conclusion is reached that there is little hope that it may be a cheaper substitute for hydrogen sintering. In the course of the re-

search work, a considerable amount of basic information on the sintering mechanism is gained. (auth)

36246 (EURAEC-635) STUDY OF FINAL PLUTONIUM PURIFICATION WITH A VIEW TO SUBSEQUENT FABRICATION OF PLUTONIUM-ENRICHED FUEL UNITS. Special Report No. 9. R. Billiau, I. Lafontaine, N. Mostin, and E. Zamorani (Société Belge pour l'Industrie Nucléaire, Brussels). Apr. 1963. Work Performed under United States–Euratom Joint Research and Development Program. Contract 27-60-7-RDB. 26p. (CONF-171-1)

From Symposium on Chemistry of Irradiated Fuel Treatment by Aqueous Process, Brussels, Apr. 1963.

The influence of several factors on the dissolution, purification, precipitation, and preparation of plutonium-bearing oxides is outlined along with the correlation between the precipitation conditions of several salts and the characteristics of the resulting oxides after calcination and sintering. The operating conditions for a nitric acid-hydrofluoric acid dissolution medium were established in order to reach a high dissolution rate of plutonium oxides and mixed uranium-plutonium oxides (clad or not) while obtaining a plutonium-bearing solution suited for purification on ion-exchange columns. During the purification cycle on Permutite SK columns the maximum rate of fixation of plutonium (in the presence or absence of metallic impurities) was determined in 8 and 10M nitric media. The influence of metallic impurities (Fe, U, Mo, Zr) on the resin capacity for different breakthroughs was studied. Decontamination factors between 10^3 and $_{\sim}10^4$ were reached for uranium and zirconium; for iron they averaged about 10^5. After a second purification cycle the total decontamination factor for uranium was approximately 10^5. The precipitation of plutonium peroxide, oxalate, and hydroxide from purified plutonium-bearing solutions was studied. At the same time, the influence of the precipitation conditions on the plutonium specific area, the dimensions of grains and conglomerates, and on the tap density of the products after calcination was determined. It is shown that the precipitation conditions also influence the sintering conditions for obtaining high geometrical density pellets. Only from ammonia-precipitated hydroxide was it possible to obtain average geometrical densities of 10.7 after low-temperature sintering (1300°C) of powders calcined at ≤500°C. (auth)

36247 (GEAP-4312) DESIGN AND FABRICATION OF SPECIAL ASSEMBLY 12-L. TWO DESIGNS FOR UTILIZING BORON AS BURNABLE POISON. S. Y. Ogawa and H. E. Williamson (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.). July 15, 1963. Contract AT(04-3)-189. 57p.

Two reactor fuel rod designs using boron burnable poison have been incorporated into a fuel bundle for irradiation testing in the VBWR to provide irradiation experience for these two designs, under actual operation in a boiling water power reactor. The designs utilize borated stainless steel cladding and a boron compound mixed in compacted powder UO_2 fuel. The test assembly was fabricated for the AEC Fuel Cycle Program, and is designated as Special Assembly 12-L. Irradiation testing in the VBWR started in February, 1963. The bundle contains 16 fuel rods in a 4 × 4 array, and is designed to be operated at a peak heat flux of 400,000 Btu/ft^2-hr. The rods have a nominal outside diameter of 0.485 inch; the cladding is 0.011-inch-thick Type 304 stainless steel tubing. A discussion is presented of the design and fabrication characteristics of the fuel rods in the bundle. (auth)

36248 (NAA-SR-Memo-7748) EVALUATION OF THE KOLDWELD PROCESS FOR JOINING APM ALLOYS. E. C. Supan (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Sept. 24, 1962. Contract [AT(11-1)-Gen-8]. 24p.

Cold pressure welding of APM alloys was investigated using the "Koldweld" process, a proprietary joining technique of Kelsey-Hayes Company. Koldwelding offers a potential alternate to other solid-state joining methods such as eutectic bonding and flash butt welding. This concluded an initial evaluation phase with a later objective of producing end closures in APM-clad UO_2 fuel rods. Butt welds were made in APM alloy rod and strip components using a double upset technique. Lap joints were made in sheet components by cold spot welds. The effect of silver plating the joint areas before Koldwelding and annealing of the joints was studied. Tensile tests were conducted on machined butt weld specimens and the lap welds were tested in shear. The evaluation was supplemented by metallographic examination of Koldwelded joints. It was concluded that APM alloys can be successfully Koldwelded with joint efficiencies approaching 100%. It is recommended that the Koldweld process be further investigated to determine if end closures can be made in APM-clad UO_2 fuel rods. (auth)

36249 (NAA-SR-Memo-8161) SOME EXPERIENCES IN FABRICATING URANIUM METAL FUEL RODS FOR ADVANCED ORGANIC REACTOR CONCEPTS. B. N. Briggs (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Jan. 23, 1963. Contract [AT(11-1)-Gen-8]. 15p.

A study was made to determine potential problems in fabricating rod-type uranium alloy fuel rods proposed for an advanced fuel element concept. A total of 11 aluminum or APM-clad fuel rods were fabricated using thin-wall niobium (or titanium) tubing as diffusion barriers between the U–10 Mo fuel and the cladding. Isostatic bonding at 8000 psi and 1100°F for periods up to 28.5 hrs did not bond the niobium to the U–10 Mo although bonding was achieved between niobium and the cladding. One fuel rod was isothermally heated for 3943 hours at 1000°F without rupturing. Six niobium-clad fuel rods were fabricated to observe the restraining properties of niobium tubing. Distortion and growth induced in the unalloyed uranium slugs by thermal cycling between room temperature and 1500°F ruptured the 0.006-in. wall tubing after 16 cycles. (auth)

36250 (NAA-SR-Memo-8202) MAGNEFORMING OF APM–UO_2 FUEL RODS. E. C. Supan (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Feb. 6, 1963. Contract [AT(11-1)-Gen-8]. 23p.

Magnetic pulse swaging was investigated as a fabrication method to eliminate the fuel-cladding annulus in APM-clad UO_2 fuel rods. Potential advantages of a zero annulus over the small fuel-cladding annulus of 0.0015 inch specified for OPHR fuel rods are cited for ease of fabrication and improved heat transfer by contact conductance. Magnetic pulse forming, a new high energy rate metalworking process, was used to fabricate three simulated fuel rods. SAP 930, 8-finned tubing (0.305 inch ID) was swaged over 0.300 inch dia pellets of stainless steel, grade "A" lavite, and normal UO_2, by the application of electromagnetic forces. A swaging technique was necessarily developed to avoid distortion of the APM cladding and to establish the magnetic pulse power requirements. Radiographic inspection of the swaged, simulated fuel rods revealed intimate con-

tact between cladding and pellets. It was shown that contact between APM cladding and UO_2 pellets was retained after thermal cycling and heat treatment to 900°F. Tensile hoop stresses are believed to be present in the swaged cladding. It is concluded that magnetic-pulse swaging is a feasible method of fabricating collapsed-clad APM–UO_2 fuel rods. It is recommended that any further development efforts include a study of cladding stresses in swaged fuel rods. (auth)

36251 (NMI-4971) FINAL REPORT TO UNION CARBIDE NUCLEAR COMPANY–BERYLLIUM TUBING PROGRAM. T. A. Tarpey, I. B. Roll, V. Nerses, and J. M. Siergiej (Nuclear Metals, Inc., Concord, Mass.). Feb. 27, 1962. For Oak Ridge National Lab., Tenn. Contract W-7405-eng-26. 156p.

Fifty-two extrusions by the shaped die technique were made during the course of the program under Phase II. Lengths of tubes up to 23 feet were successfully extruded. A higher reduction ratio (28×) than that used in Phase I (23×) was successfully employed together with longer billets to increase the yield by 85 percent and thus reduce the cost of tubing. Efforts to reduce costs by increasing die life (which in Phase I was limited to one extrusion) were also successful: during this program, six extrusions were accomplished through one die with little sign of die wear. Inspection of the tubing indicates that the tubes are basically sound and that they can be reproduced with a good degree of consistency. The room temperature burst test data indicate that, in general, as-extruding tubing with adequate surface preparation gives the highest hoop stress values. Reduction ratio and extrusion temperature (at least in the range employed in Phase II) have little if any effect on the hoop stress results. Surface quality and surface damage influence the strength of tubing as determined by hoop stress: tubing on which surface damage had not been adequately removed and tubing with poor surface quality exhibited low strength. Inspections by Dy-Chek penetrant techniques and the helium leak detector did not reveal any abnormalities in the tubing as a result of the fabrication method and refinements employed. The short-time, elevated temperature burst strength was determined for beryllium tubing hot extruded with a reduction in area of 23×. The hoop stresses varied linearly from 27,000 to 10,000 psi in the temperature range 800 to 1300°F. The strength of tubing extruded with a 28× reduction was found to be similar to that of tubing extruded at 23× reduction. A limited number of stress-rupture determinations were made at 600°C for beryllium tubing fabricated under normal conditions. These tests were for periods of 0.1 to 10 hours. Surface quality of the tubes, both on the inside and outside surfaces, can be controlled to some extent during extrusion. However, the greatest improvement and control of surface quality was made with such postextrusion treatments as chemical etching and liquid and dry honing. (auth)

36252 (NUMEC-P-8) DEVELOPMENT OF PLUTONIUM BEARING BEARING FUEL MATERIALS. Monthly Progress Letter, July 1–July 31, 1960. H. J. Garber (Nuclear Materials and Equipment Corp., Apollo, Penna.). Aug. 5, 1960. Contract AT(30-1)-2389. 6p.

Progress is reported on developments in plutonium-bearing fuel materials in terms of reactor physics and engineering parametric studies, fuel preparation and characterization, fabrication and evaluation of fuel shapes, radiation testing and evaluation, and chemical reprocessing. (B.O.G.)

36253 (NUMEC-P-59) DEVELOPMENT OF PLUTONIUM-BEARING FUEL MATERIALS. Monthly Progress Letter, July 1963. Karl H. Puechl (Nuclear Materials and Equipment Corp., Apollo, Penna.). Aug. 10, 1963. Contract AT(30-1)-2389. 4p.

Progress is reported on developments in the preparation of PuO_2 and UO_2, for the fabrication of mechanically mixed and coprecipitated fuel materials. Data are tabulated for conditions of PuO_2 preparation by the continuous oxalate process, and for process conditions for coprecipitation of UO_2–0.5 wt % PuO_2. A discussion is included of the additive effects of strontium carbonate on the sinterability of PuO_2, and SiO_2 on the sinterability of the mixed oxides. (B.O.G.)

36254 (WAPD-245) GAS PRESSURE BONDING OF PRODUCTION SIZE PWR CORE 2 PLATE TYPE FUEL ELEMENTS CONTAINING CERAMIC FUEL. F. O. Bingman and C. R. Woods (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). May 1963. Contract AT(11-1)-Gen-14. 125p.

Several production-size PWR Core 2 plate-type fuel elements were fabricated and evaluated to establish the optimum parameters to yield acceptable fuel elements by the gas pressure bonding process. The evaluation included the effect of a post-bonding heat treatment, assembly clearance, and bonding temperature on the bond quality, fuel clad reaction, surface smoothness, over-all dimensions, corrosion resistance of the fuel element, and the mechanical properties of the individual compartments. The results of the evaluation indicate that acceptable production-size fuel elements are attained when the indicated fabrication variables are maintained within reasonable operative limits. (auth)

36255 HOT-PRESSING CERAMICS IN ALUMINA DIES. R. M. Spriggs, L. A. Brissette, M. Rossetti, and T. Vasilos (Avco Corp., Wilmington, Mass.). Am. Ceram. Soc. Bull., 42: 477-9(Sept. 1963).

Exploratory experiments showed that it was possible to prepare a wide variety of polycrystalline ceramic oxides of very high density and fine grain size by hot pressing in high density alumina dies. The contaminating and reducing atmosphere of conventional graphite dies was eliminated. Higher pressures and hence lower temperatures were allowed; and the fabrication of otherwise easily reduced oxides was possible. The use of a dial indicator permitted continuous monitoring and measurement of ceramic body compression, sintering and densification effects and stages, and specific control, where desired, of porosity levels. A hot ejection chamber allowed the molding of materials whose expansions were less than that of the die body. Examples are given of the ceramic oxides successfully fabricated to high density by this technique: the refractory oxides Al_2O_3, Cr_2O_3, MgO, Y_2O_3; defect oxides such as NiO, ZnO, TiO_2, Nb_2O_5, WO_3, and a number of rare earth oxides. (auth)

36256 PELLETIZING TO DISPERSE NUCLEAR FUEL IN FUEL ELEMENTS. W. H. Duckworth, A. K. Smalley, and M. C. Brockway (Battelle Memorial Inst., Columbus, Ohio). Am. Ceram. Soc. Bull., 42: 494-7(Sept. 1963).

A pelletizing process was used successfully in the laboratory to replace mixing of fuel particles and matrix powder as a step in the processing of dispersion-type nuclear fuel elements. In so doing, the following benefits were obtained: more nearly equidistant spacing of fuel particles in the matrix; improved graphite or ceramic matrix structures; surfaces free of fuel particles; elimination of damage to coatings on ceramic-coated fuel particles; and improved control over the fuel content of elements. In the process, a slip of matrix material is sprayed on a bed of tumbling fuel particles so that each particle forms the core of a

pellet of green matrix. The pellets are then compacted and sintered in the same general way as are blends of fuel particles and matrix material in usual processing. (auth)

36257 BRAZING OF SANDWICH STRUCTURES OF COLUMBIUM ALLOYS. Mel M. Schwartz. Current Eng. Practice, 5: No. 8, 21-5(Feb. 1963).

A study of brazing alloys for Nb was conducted using a vacuum furnace at 3450°F. Brazing alloys for Nb including Pt, Ti, Zr, and Pd were evaluated. (Rev. Metal Lit., 20: No. 7, July 1963)

36258 PREPARATION OF LANTHANUM AND CERIUM METAL BY THE FUSED SALT ELECTROLYSIS. Tadashi Kuroda and Osamu Matsumoto. Denkai Kagaku, 30: E149-53(1962).

The technique and equipment for preparing pure La and Ce metals by electrolysis of fused lanthanum chloride and cerium (III) chloride with potassium chloride is given. Preparation of the anhydrous chlorides and the effect of current efficiencies of metal yield are also discussed. (Rev. Metal Lit., 20: No. 8, Aug. 1963)

36259 PREPARATION OF FUEL ELEMENTS FOR THE ROSSENDORF RING ZONE REACTOR. H. Steinkoppe and L. Loeffler (Zentralinstitut fllr Kernphysik, Rossendorf, Ger.). Kernenergie, 6: 315-20(July 1963). (In German)

The technology for the preparation of rod-shaped dispersion fuel elements using the compound extrusion method is described. The extrusion process was modified so that a separate operation for sealing the ends of the fuel elements was avoided. The methods used for testing and the final surface treatment of the fuel elements are described. (tr-auth)

36260 ONE SHOP'S EXPERIENCE IN MACHINING BERYLLIUM. Don Titus. Machinery (N. Y.), 69: No. 8, 109-12(Apr. 1963).

Details of machining, milling, and lapping methods for producing surface finishes to 2 microinches on Be components are given. Due to the toxicity of the material extreme precautions are taken with ventilating equipment and protective clothing. Descriptions and photographs of the ventilation equipment are included. (Rev. Metal Lit., 20: No. 7, July 1963)

36261 URANIUM SHEET. W. F. Biddle. Metal Treatment Drop Forging, 30: 147-53(Apr. 1963).

Structures, phases, dislocation phenomena, and brittle-ductile transitions in uranium sheet are reviewed. A description is given of the various methods of rolling sheet material in different crystallographic phases, and the oxidation, reduction, and recrystallization behavior is discussed. (Rev. Metal Lit., 20: No. 7, July 1963)

36262 URANIUM SHEET. W. F. Biddle. Metal Treat. Drop Forging, 30: 189-98(May 1963).

A review of the manufacturing processes, which include cold and hot rolling, of uranium sheet, followed by annealing to recrystallize the deformed structure is presented. Determination was made of the physical properties that are affected by temperature and various impurities. Data are given for the various difficulties caused by the metal reactivity, radioactivity, anisotropic thermal expansion, and allotropic changes during the manufacturing processes. (Rev. Metal Lit., 20: No. 8, Aug. 1963)

36263 URANIUM SHEET. W. F. Biddle. Metal Treat. Drop Forging, 30: 232-8(June 1963).

Manufacturing processes for uranium sheet are reviewed, and the ways in which the various problems are surmounted are described. (TCO)

36264 DEPOSITING METALS ON URANIUM. Prod. Finishing (Cincinnati), 27: No. 8, 158; 160-1(May 1963).

A method for the anhydrous coating of uranium with Zn using a zinc acetate-formamide plating bath is presented. A porosity test method for electroplated coatings on uranium is given. (TCO)

36265 THE FABRICATION OF SLIP-CAST URANIA CERAMICS. F. P. Bick, P. Rado, and A. A. Philpott (Worcester Royal Porcelain Co., Ltd., Eng.). Trans. Brit. Ceram. Soc., 62: 119-26(Feb. 1963).

The slip-casting of crucibles of non-stoichiometric urania for the melting of uranium metal and their subsequent sintering in a neutral atmosphere at a temperature about half that of the melting point of urania are described. Additions of organic binder have a marked effect on the viscosity of the slip, the main factors in casting being particle-size distribution, pH value, and concentration. Calcining the starting material gives the desired sintering behavior, the most important factor being the oxygen metal ratio of the urania. (auth)

36266 HOT ROLLING OF Nb IN VACUUM AND IN PROTECTIVE ATMOSPHERE. I. M. Pavlov, A. E. Shelest, Ya. B. Gurevich, V. L. Orzhekhovskii, and A. P. Bashchenko. Tsvetn. Metal., No. 5, 63-7(May 1963). (In Russian)

Temperature dependence of Nb hot rolling indices in a vacuum of $\sim 10^{-5}$ mm Hg and in air was studied, and friction coefficients during heating and rolling in argon and in 10^{-2} mm Hg vacuum, followed by rolling in air, were compared. (R.V.J.)

36267 JOINING CURRENT CONTACTS TO SUPERCONDUCTING WIRE. K. M. Ralls, A. L. Donlevy, R. M. Rose, and J. Wulff (Massachusetts Inst. of Tech., Cambridge). Welding J. (N. Y.), 42: 411s-16s(Sept. 1963).

The influence of contact resistance at the joint between normal and superconducting materials, where the current is passed into the superconductor, is cited. A physical model is proposed for the interface, which leads to reasonable predictions of properties. The prevailing joining techniques are reviewed. Typical specimens were made, utilizing each of the popular techniques, and contact resistances were measured at low magnetic fields. The two techniques which yielded the lowest contact resistance were spot welding to platinum foil and ultrasonic wetting with indium and cold welding; these were both examined in high field, where the former method showed appreciable magnetoresistance compared to the latter. The ultrasonic wetting-cold welding technique is, therefore, suggested as a basis for further development with a view to optimizing its properties. (auth)

36268 JOINING OF COLUMBIUM AND TANTALUM. R. G. Gilliland and E. A. Franco-Ferreira. p.169-97 of "Columbium and Tantalum." New York, John Wiley and Sons, Inc., 1963.

Mechanical joining, resistance, TIG, and electron beam welding and brazing of Nb and Ta are discussed. The importance of a protective atmosphere obtained by welding in a controlled atmosphere chamber or by use of a trailer shield or electron beam is stressed. (Rev. Metal Lit., 20: No. 7, July 1963)

36269 METALLOGRAPHY OF COLUMBIUM AND TANTALUM. W. D. Forgeng. p.507-34 of "Columbium and Tantalum." New York, John Wiley and Sons, Inc., 1963.

Sectioning, grinding, electrolytic polishing, and etching of Nb and Ta are reviewed. Microstructures of Nb and Ta alloys as affected by O, C, and N content are discussed,

along with phase identification by x-ray diffraction. (Rev. Metal Lit., 20: No. 7, July 1963)

36270 EFFECT OF TEMPERATURE AND PRESSURE ON CONTAMINATION OF REFRACTORY METALS. [F. R. Cortes] (Universal-Cyclops Steel Corp., Bridgeville, Penna.). 23p. (CONF-53-6)

From 1962 World Metal Show, New York, Oct.-Nov. 1962.

Work was carried out to evaluate the fabricability and properties of some refractory metal alloys rolled under various high-purity atmospheres and on the basis of this evaluation determine the maximum purity level of the processing environment required to maintain or improve the properties of refractory metal sheet. Vacuum-rolled Ta–W, F-48, D-31, and TZM alloys were evaluated in the as-rolled condition. In general, vacuum-rolled strip surfaces were bright and appeared cold-finished. There appeared to be a definite relationship between rolling parameters at a given pressure and the occurrence of edge cracks. Tensile strengths of strips rolled at less than one micron showed a decreasing trend with increased rolling temperature. (M.C.G.)

36271 MOLYBDENUM HONEYCOMB FOR AEROSPACE STRUCTURES. Mel. M. Schwartz (Martin Co., Baltimore). 20p. (CONF-57-3)

From Electron Beam Symposium, Boston, Mar. 1963.

The best welded joints in foil and sheet gages of Mo and its alloys to date were produced by an electron beam welding technique. By this technique corrugated TZM (Ti–Zr–Mo alloy) was welded into a honeycomb structure Billets of the honeycomb structure were cut into slabs and made into test panels. The best method found for slabbing and finishing the honeycomb involved use of heating lamps and blankets during sawing and sanding. In aerospace structures honeycomb construction provides local stiffness at a low weight. (A.G.W.)

36272 BRAZING OF INCONEL FOR SERVICE AT HIGH TEMPERATURES AND PRESSURES. H. H. Hoffman (United Nuclear Corp., New Haven). 29p. (CONF-53-7)

From 1962 World Metal Show, New York, Oct.-Nov. 1962.

A program to join reactor instrumentation assemblies composed of Inconel material by furnace and induction brazing was completed. An 82 wt % nickel–18 wt % gold alloy composition with a brazing range of 1850 to 1900°F was employed for structural joints in low-neutron-flux locations. A braze alloy of 71 wt % nickel–19 wt % chromium–10 wt % silicon and a brazing range of 2150 to 2200°F was used to join components operating in high-temperature, high-flux regions. A diametral clearance of .002 to .006" between the faying surfaces of the joint was used throughout the program. High-frequency induction heating in combination with vycor glass tube furnaces was employed to braze nearly all the components. Furnace brazing in closed retorts was used at other times. Close control of atmosphere purity, joint dimensional tolerances, alloy placement, and temperature was maintained to produce sound, leak-tight brazed joints. (auth)

36273 A PRESS FOR EXTRUDING EASILY OXIDISING METAL BILLETS. (to Schloemann AG). British Patent 931,973. July 24, 1963. Priority date May 4, 1961, Germany.

A press to permit metal to be passed through the stages of heating, extrusion, and cooling in a protective gas atmosphere is patented. Instead of the conventional heating furnace, an electrical heating device directly precedes the billet container and is in axial alignment with it. The hot billet is transferred to the billet container by the punch of the press. The space between the head of the press and the bedplate is enclosed in a shell, which may contain a protective gas. (M.P.G.)

36274 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTOR FUEL ELEMENTS. Alan Frederick Taylor (to United Kingdom Atomic Energy Authority). British Patent 934,413. Aug. 21, 1963. Filed July 29, 1960.

A reactor fuel element enclosed in a very thin-walled sheath with end caps welded to the sheath is patented. The end caps are fitted into the sheath before welding by an interference fit created by a taper on the end caps. The taper is preferably 0.005 in./in. of end cap length. The end caps are curved at their bases to provide ease of entry into the sheath. (M.P.G.)

36275 METHOD OF PREPARING A CERAMIC FUEL ELEMENT. Wilfred T. Ross, Clarence H. Bloomster, and Robert E. Bardsley (to U. S. Atomic Energy Commission). U. S. Patent 3,102,850. Sept. 3, 1963.

A method is described for preparing a fuel element from −325 mesh PuO_2 and −20 mesh UO_2, and the steps of screening −325 mesh UO_2 from the −20 mesh UO_2, mixing PuO_2 with the −325 mesh UO_2, blending this mixture with sufficient −20 mesh UO_2 to obtain the desired composition, introducing the blend into a metal tube, repeating the procedure until the tube is full, and vibrating the tube to compact the powder are included. (AEC)

36276 APPARATUS FOR GRINDING SPHERICAL BODIES. Roy F. Burch, Jr. (to U. S. Atomic Energy Commission). U. S. Patent 3,104,502. Sept. 24, 1963.

A relatively inexpensive device is described for grinding rough ceramic bodies into accurate spherical shapes using a conventional drill press and a belt sander. A horizontal disk with an abrasive-surfaced recess in its lower face is mounted eccentrically on a vertical shaft which is forced downward against a stop by a spring. Bodies to be ground are placed in the recess and are subjected to the abrasive action of the belt sander as the disk is rotated by the drill press. (AEC)

Properties and Structure

Refer also to abstracts 35773, 35783, and 36859.

36277 (62-RL-3069M) LOW CYCLE FATIGUE—A REVIEW. L. F. Coffin, Jr. (General Electric Co. Research Lab., Schenectady, N. Y.). June 13, 1962. 34p.

A sufficiently large body of literature on the subject of low cycle fatigue now exists to establish it as a separate and well-defined field of investigation. The unique features of this area of investigation and the state of the art are discussed as they are of importance to the designer, the metals engineer, and the metallurgist. In addition, the role of temperature and time effects on the phenomenon are emphasized. An important distinction in interpretation can be made, depending on whether temperature dependent processes are operating, and the experimental results are treated from this consideration. The significance of cyclic plastic strain is emphasized and its application to design discussed. (auth)

36278 (AD-287159) ON THE MECHANICAL BEHAVIOR AND FRACTURE MORPHOLOGY OF EPOXY RESIN. C. E. Feltner (Illinois. Univ., Urbana). Aug. 1962. 14p. (TAM-224)

Tensile specimens of irradiated and non-irradiated epoxy resin were broken by static loading using various strain rates and a study was made of the origin, development, and

characteristic patterns of the fracture surface markings. In nearly all cases fractures originated at inclusions or bubbles even when reasonable care was exercised in casting the resin. Epoxy resin exhibits 3 different types of stress-strain curve which have been termed normal, transition, and premature. The slope of the stress-strain curve at fracture serves as an index of the degree of prematurity or normalcy of the fracture; positive and negative slopes being termed premature and normal, respectively. Examination of the corresponding fracture surfaces discloses that normal fractures are always accompanied by a considerable amount of slow crack extension while on the other hand little or no slow crack growth occurs in a premature fracture. Quantitatively, the relation between the fracture stress and the stable flaw size agrees reasonably well with the Griffith theory when the mirror is considered to be the Griffith flaw. Fractures started internally in some of the epoxy samples but at the edges of all of the others. In most respects the characteristic features of a fracture surface of epoxy resin are similar to those of other polymers such as polymethyl methacrylate. (auth)

36279 (AD-287509) DESIGN DATA STUDY FOR COATED COLUMBIUM ALLOYS. Bimonthly Report No. 4, June 21, 1962 through August 21, 1962. J. D. Gadd (TAPCO. Div. of Thompson Ramo Wooldridge Inc., Cleveland). Sept. 21, 1962. Contract NOw 62-0098-c. 12p.

The screening tests of 7 protective coatings applied on D-14 alloy and of Pfaudler, TRW, and Vought coatings on FS-85 alloy were completed and reviewed. The Pfaudler and TRW coatings were selected for an extensive design data study of coated FS-85 alloy. Test specimens for the design data study were prepared from 30 mil FS-85 alloy sheet and are being coated by Pfaudler and TRW. Tensile tests were conducted on uncoated FS-85 alloy at temperature intervals from room temperature to 2600°F, establishing base-line properties for evaluation of the coating-base metal systems. (auth)

36280 (AD-291456) THERMOELECTRIC MATERIALS FOR POWER CONVERSION. Quarterly Progress Report No. 4 (Final), February 1, 1961–January 31, 1962. F. D. Rosi and E. F. Hockins, eds. (David Sarnoff Research Center, Princeton, N. J.). Feb. 15, 1962. Contract NOBS-84660. 32p.

The thermal conductivity of heavily doped Ge–Si alloys was found to be low enough that the thermoelectric figure of merit was raised to usefully high values at elevated temperatures. Methods were developed for producing and analyzing the alloys; their thermoelectric properties were measured; and a power generating thermocouple was made using Ge–Si alloys as the n- and p-type thermoelements. The highest efficiency measured was 7.0%. Preliminary tests on segmented power generating thermocouples constructed from tellurides were also encouraging. Materials research on metal trisilicides, rare earth sulfides, and ternary compounds and alloys is also reported. Phase diagrams, thermoelectric properties, and electric conductivity are among the data included. (D.C.W.)

36281 (AD-295526) SHEAR STRENGTH PROPERTIES OF REFRACTORY METAL FASTENERS. Report 9346. Final Report. (McDonnell Aircraft Corp., St. Louis). Jan. 10, 1963. Contract AF33(657)-7749. 8p.

Ultimate shear strength tests were conducted in air at room temperature and 1600°F. Testing was performed on five refractory alloys; (Cb–10Ti–10W, Cb–10Ti–3Zr), Mo–O,5Ti, Cb–1Zr, Cb–15W–5Mo–1Zr (F48); and seven types of fasteners; solid rivets, explosive rivets, Cr-coated rivets, Huck rivets, Deutsch rivets, DuPont explosive rivets, and solid bolts. The F-48 solid rivets showed the highest shear strength both at room temperature and at 1600°F (87,000 psi and 34,500 psi). Data are presented both in tabulated and in bar graph form. (auth)

36282 (AD-295529) DIRECTIONAL TENSILE PROPERTIES OF F48 COLUMBIUM ALLOY AT ROOM TEMPERATURES. Report 9339. Final Report. R. H. Brookes (McDonnell Aircraft Corp., St. Louis). Sept. 27, 1962. Contract AF33(657)-7749. 7p.

This test was conducted to establish the extent of variation in the tensile properties of F48 Niobium Alloy Sheet. Sixty-four tensile specimens were fabricated from thirteen different heats of F48 alloy, specimens were taken longitudinal, transverse, and at 45 degrees to the rolling direction. Tensile tests were conducted in the Tatnall testing machine at room temperature on specimens taken 45 degrees from the rolling direction, and the Ftu, Fty, and percent elongation in 1.00 inch were determined. The Ftu varied between 76,000 and 124,000 psi, the Fty between 75,500 and 102,500 psi, and the elongation between 9 and 21%. (auth)

36283 (AD-295530) PRELIMINARY COMPARATIVE EVALUATION OF SEVERAL COMMERCIALLY AVAILABLE COLUMBIUM COATING SYSTEMS. Report 9341. J. P. O'Connor (McDonnell Aircraft Corp., St. Louis). Aug. 28, 1962. Contract AF33(657)-7749. 51p.

It is necessary to obtain more information concerning the commercially available niobium coating systems before a firm decision can be made on a coating vendor for Project Asset. Coated specimens were submitted for testing. The specimens consisted of coupons, panels, and tubes which were torch tested at 2600 to 3000°F or oxidation tested for individual cycles of one hour at 2500°F. The results of this comparative testing indicate none of the vendors has an outstanding coating system. (auth)

36284 (AD-295547) EFFECTS ON THE MECHANICAL PROPERTIES OF LB-2 COATED COLUMBIUM–5% ZIRCONIUM ALLOY INSPECTED BY AN OXIDATION CHECK TEST. Report 9340. Final Report. J. P. O'Connor (McDonnell Aircraft Corp., St. Louis). Apr. 26, 1962. Contract AF33(657)-7749. 32p.

An oxidation check test is the only known method at present for reliably checking for coating defects in LB-2 coated columbium alloys. An investigation is required to determine if any adverse effects are incurred by the additional heating during said test before it can be specified for use at MAC. Tensile specimens were prepared and tested in the as-received, coated and fired once, and coated and fired twice conditions with additional exposures of the latter to 1900°F for 30 minutes in both air and argon and 2 hours in argon. Fty, Ftu, and % elongation in one inch were determined for specimens in each of the six conditions. DPH-1 kg microhardnesses were determined for each of the seventeen specimens. The oxidation check test has a negligible effect on the mechanical properties of the metallic substrate. (auth)

36285 (AERI-P/R-2) THE EFFECTS OF SILVER AND DIELECTRICS ON GRAIN BOUNDARIES OF MOLYBDENUM AT THEIR MELTING POINTS. Sang Soo Lee and Dae Yoon Park (Atomic Energy Research Inst., Seoul, Korea). Dec. 31, 1963. 6p.

Sheets of molybdenum used in the evaporation of silver get easily fractured, whereas those used in the evaporation of dielectrics, such as PbS, MgF_2, and ZnS, keep substantially the strong mechanical property. An attempt was made to explain the cause of this difference by observing under the reflection microscope the grain boundaries in

molybdenum revealed by concentrated sulfuric acid etching. Although the general shape of the grain of pure molybdenum does not change, the dislocation etch pits within the grain completely disappear when silver diffuses in the molybdenum. And the fracture in the silver-diffused molybdenum takes place along the line of grain boundaries, the size of the grain being a few tens of microns in length. When the molybdenum sheet is heated in contact with the dielectrics of PbS and MgF_2, the size of the grain seem more random and the corners of the grain become round. In this case the inter-grain binding force is still strong and fracture hardly takes place. (auth)

36286 (ANL-6731) GALVANOMAGNETIC PROPERTIES OF URANIUM MONOSULFIDE. Casimir W. Kazmierowicz (Argonne National Lab., Ill.). June 1963. Contract W-31-109-eng-38. 28p.

The magnetic and galvanomagnetic properties of US, including resistivity, magnetoresistance, and Hall effect, were studied. The resistivity was found to be approximately a hundred times higher in US than in the common ferromagnetic metals, but the temperature dependence of resistivity was similar, showing an abnormal decrease below the Curie point. The magnetoresistance of US was found to be negative with a sharp minimum at the Curie point. The study of the Hall effect revealed that two Hall coefficients could be identified. The extraordinary Hall coefficient, which is related to the magnetization of the material, was found to be proportional to the second power of the resistivity. The ordinary Hall coefficient R_0, related to the applied field, was found to be positive and temperature dependent, with a maximum near the Curie point. The temperature dependence of R_0 constituted the biggest dissimilarity between US and other ferromagnetic substances. The effective carrier concentration evaluated from this coefficient was 0.45 hole per atom at absolute zero. The study of the magnetic properties yielded values of the saturation magnetization at various temperatures which indicated that at absolute zero the atomic moment is 1.05 ± 0.03 Bohr magnetons. These results are correlated with a band picture based on overlapping 7s and 5f bands. (auth)

36287 (ARL-63-104) A STUDY OF THE Ti–Zr–O SYSTEM. R. F. Domagala (Illinois Inst. of Tech., Chicago. Armour Research Foundation). June 1963. Contract AF33(616)-7074. 38p. (AD-410593)

Phase relationships along the vertical sections from Ti to ZrO_2 and from TiO to ZrO_2 were investigated in the Ti–Zr–O system. Arc melted alloys were prepared using high-purity ingredients. Samples were annealed, quenched, and subjected to metallographic preparation and study. A cursory melting point-composition study was conducted. Approximately 390 duplicate heat-treated specimens were forwarded to ARF for correlative work. The vertical section between Ti and ZrO_2 consists of areas of β, $\alpha + \beta$, α, $\alpha + X$, $\alpha + X + ZrO_2$, $\alpha + ZrO_2$, and ZrO_2 phases. The "X" phase is presumed to be TiO; some uncertainty still exists in this identification. The section between TiO and ZrO_2 was observed to consist of TiO, TiO + ZrO_2, TiO + α + ZrO_2, α + ZrO_2, and ZrO_2 phases. The amount of α phase never amounts to more than a few per cent by volume. Typical microstructures along both vertical sections are presented; x-ray and chemical analytical data are tabulated. A limited effort was directed toward a reexamination of the Ti–O binary system in the 10–25 wt % oxygen region. Some arc melting, heat treating, and microprobe service type work was done. (auth)

36288 (ASD-TDR-63-493) RESEARCH ON CHROMIUM-BASE ALLOYS EXHIBITING HIGH-TEMPERATURE STRENGTH, LOW-TEMPERATURE DUCTILITY, AND OXIDATION RESISTANCE. Carl S. Wukusick (General Electric Co. Advanced Technology Services, Cincinnati). June 1963. Contract AF33(657)-8471. 73p. (AD-411116)

Improvements in ductility, strength, and oxidation resistance of chromium were obtained by combinations of small amounts of rhenium and reactive metal additions (yttrium, thorium, and hafnium). Dispersions, formed by reactions between impurities and reactive metal additions or by the addition of dispersoid-forming elements, resulted in increased ductility and strength. Combinations of reactive metal additions were more effective in improving ductility and oxidation resistance than single additions. Possible mechanisms are outlined. Two alloys exhibited resistance to nitrification for 100 hours at 2500°F in thick sections. These were a Cr–10 wt % Re + Y, Th, and Hf alloy and a Cr–15 vol % Y_2O_3 – 1 wt % Y cermet. Thin sections exhibited less resistance to nitrification. Attempts to form a more protective Al_2O_3 surface layer through additions of Al (up to 5 wt %) to Cr–Re and Cr–W alloys were not successful, and detrimental internal oxidation occurred in all alloys. Experiments aimed at substitution for all or a part of the rhenium in the ductile Cr–35 at. % Re alloy were not successful. Combinations of low rhenium contents and dispersions resulted in an improved combination of strength, oxidation resistance, and ductility. (auth)

36289 (ASD-TDR-63-567(Pt.I)) STUDY OF LOCAL ORDER AND SOLID-SOLUTION STRENGTHENING IN COLUMBIUM ALLOYS. P. S. Rudman (Battelle Memorial Inst., Columbus, Ohio). May 1963. Contract AF33(657)-8844. 33p. (AD-411549)

The results of experimental x-ray diffuse scattering for Nb–Ti alloys are presented, showing that this system apparently exhibits relatively little order. The theory of diffuse scattering is re-derived, yielding an order-fluctuation-dependent small-angle scattering. The question of the range of order fluctuations is treated. (auth)

36290 (CNLM-4408) SHORT TIME STRENGTH DATA FOR CS 1830 SERIES Cb–1Zr ANNEALED AT 2200F. W. L. Watson (Pratt and Whitney Aircraft Div., United Aircraft Corp. Connecticut Aircraft Nuclear Engine Lab., Middletown). Feb. 8, 1963. Contract AT(30-1)-2787. 11p.

A summary is presented of short-time strength data for CS1830 series Nb–1Zr material. The data are presented as a function of fabrication history or the amount of cold work received during fabrication. Three fabrication categories were considered for comparison: forgings and extrusions; bar, plate, rod, and pipe; and sheet and tubing. Forgings and extrusions having received no cold work showed the highest strength over the entire temperature range 68 to 2800°F; bar, plate, rod, and pipe received moderate cold work and showed lower strength than forgings and extrusions but higher strength than sheet and tubing in the temperature range 2000 to 2800°F. (auth)

36291 (CONF-39-88) UO_2 THERMAL CONDUCTIVITY AT ELEVATED TEMPERATURES. M. F. Lyons, R. L. Straley, D. H. Coplin, B. Weidenbaum, and T. J. Pashos (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.). Mar. 1, 1963. Contract AT(04-3-189). 6p.

From American Nuclear Society 9th Annual Meeting, Salt Lake City, June 1963.

The thermal conductivity of polycrystalline UO_2 was determined indirectly at 1900 to 2450°C, and the results are plotted on a conductivity vs temperature graph along with

literature data for lower temperatures. The conductivity values at 1900 to 2450°C are nearly constant at ~0.018 w/cm-°C, although a small upturn at temperatures above 2450°C is indicated. The determinations were made from measurements of the radial temperature profiles in irradiated fuel capsules, and the effects of the activation energy of grain growth on these determinations are discussed. (D.L.C.)

36292 (DPST-63-74-7) HYDRIDE ORIENTATIONS AND MECHANICAL PROPERTIES OF THIN-WALLED ZIRCALOY TUBING. USAEC-AECL Cooperative Program Monthly Progress Report, July 1963. R. P. Marshall (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). Aug. 1963. Contract AT(07-2)-1. 5p.

Additional study of the orientation of zirconium hydride platelets in thin-walled Zircaloy tubing is being conducted to define the relationship of the fabrication techniques and associated Zircaloy structures to the susceptibility of the tubing to preferred hydride orientations. Second, the work will assess qualitatively the effects of oriented hydride platelets on the mechanical behavior of tubes under several stress conditions. The first stress orientation tests were run on circumferential specimens from the six types of tubing. Work was also begun on the preparation of specimens for texture measurements by x-ray diffraction. Since the final texture results were approximately two months away, the primary textures of the tubing were estimated by analysis of previously published texture data and the anisotropy of strain behavior during tensile tests. These preliminary data indicated that the susceptibility to stress orientation of the hydride platelets varied widely between tubing with similar textures and/or fabricated by nominally similar processes. (auth)

36293 (DRI-2079) INVESTIGATION OF THE CHARACTERISTICS OF INTERMETALLIC COMPOUNDS AS THERMIONIC EMITTERS. First Annual Technical Summary Report, November 1, 1961 to October 31, 1962. C. B. Magee, M. J. Pool, W. D. McMullen, R. C. Jerner, and D. G. Ellis (Denver. Univ. Denver Research Inst.). Dec. 31, 1962. Contract NONR 099-362. 43p. (AD-295109)

Equipment was designed and fabricated for the determination of evaporation rates of intermetallic compounds by means of the Langmuir free evaporation technique. Evaporation rate data were obtained in the temperature range from 900 to 1200°C for metallic Be and for $ZrBe_{13}$, $NbBe_{12}$, and Nb_2Be_{17}. Assuming the evaporating species to be monatomic Be, vapor pressures were calculated from evaporation rates and Van't Hoff plots were made. The standard enthalpies of sublimation, in kilocalories per gram atom Be determined from these plots are: for Be, 79.0; for $ZrBe_{13}$, 85.0; for $NbBe_{12}$, 19.9 and 59.5; and for Nb_2Be_{17}, 98.0 and 55.8. That there are two enthalpies of sublimation for the Nb beryllides may be due to the existence of a heretofore unknown beryllide intermediate in Be content between Nb_2Be_{17} and $NbBe_3$. Possibly both $NbBe_{12}$ and Nb_2Be_{17} decompose upon evaporation to the intermediate species which decomposes to $NbBe_3$. A high-vacuum diode for the determination of thermionic emission parameters of intermetallic compounds was designed and constructed. A second diode with improvements over the first design is being constructed. (auth)

36294 (EUR-337.e) DEVELOPMENT OF METHODS FOR THE DETERMINATION OF THE HIGH TEMPERATURE THERMAL DIFFUSIVITY OF UC. C. Mustacchi and S. Giuliani (European Atomic Energy Community. Nuclear Research Center, Ispra, Italy). 1963. 27p.

A modulated electron gun was used to determine the thermal diffusivity of uranium carbide in the range 1000 to 2000°C. Both sine wave and pulse techniques were applied to thin wafer-shaped samples of carbide. The temperature of the hind face was detected by means of a photocell-oscilloscope arrangement. Arc-cast carbide yielded a value 0.049 ± 0.004 cm^2 sec^{-1} for thermal diffusivity in the range in question. Values for emissivity and electrical and thermal conductivity were measured or derived for uranium carbide. (auth)

36295 (EUR-378.f) EVOLUTION MICRO ET MACROSTRUCTURALE DES COMPOSITES Al–Al_2O_3 SOUS CYCLAGE THERMIQUE. (Micro- and Macrostructural Evolution of Al–Al_2O_3 Compounds Under Thermal Cycling). G. Beghi, P. Guyot, and G. Piatti (European Atomic Energy Community. Nuclear Research Center, Ispra, Italy). 1963. 40p. (CONF-167-1)

From Journees Metallurgiques d'Automme, Paris, Oct. 1962.

SAP samples containing 4, 7, 10, and 14% Al_2O_3 were subjected to thermal cycling from 30 to 500°C and 30 to 600°C, the dimensional analysis, micrographic analysis, and mechanical property check being carried out. The variations were slight but the ductibility was found to improve at 450°C in the 30 to 600°C cycling. (auth)

36296 (HW-78260 CH) PROPERTIES OF CERAMIC FUEL MATERIALS. L. A. Pember (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). June 29, 1963. Contract AT(45-1)-1350. 4p.

A chart is given which presents in condensed form the physical, mechanical, and fabrication properties of U, Pu, and Th borides, carbides, nitrides, oxides, phosphides, sulfides, and silicides. A bibliography is also given. (D.L.C.)

36297 (IS-594) THE SOLUBILITY OF HOLMIUM IN COPPER, SILVER AND GOLD. W. J. Wunderlin, B. J. Beaudry, and A. H. Daane (Ames Lab., Ames, Iowa). [Jan. 28, 1963]. Contract [W-7405-eng-82]. 15p.

The solid solubility of holmium in copper, silver, and gold was determined using metallographic techniques. The composition of the first intermetallic compound in these systems was found to be Cu_4Ho, Ag_7Ho_2, and Au_3Ho. These compounds form eutectics with the solvent metals which melt at 868, 787, and 778°C, respectively. (auth)

36298 (NAA-SR-Memo-8060(Rev.)) Al-ALUMINIZED COATING AS HYDROGEN BARRIER ON ZIRCONIUM ALLOYS. J. P. Page and G. V. Sneesby (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Jan. 14, 1963. Contract [AT(11-1)-Gen-8]. 10p.

Aluminized coatings were formed on the surfaces of zirconium 3Z1, and Zircaloy-2 by a diffusion treatment process. The coating thickness on a specimen of reactor-grade zirconium was determined to be about 0.5-mil (0.0005-in.) by metallographic examination. The composition of the coating on a specimen of Zircaloy-2 was determined to be primarily $ZrAl_3$, with some $ZrAl_2$, by x-ray diffraction analysis. Some hydrogen contamination of the zirconium alloy occurred during diffusion treatment; hydrogen contents of about 20 and 200 ppm were found in as-received and as-coated specimens of Zircaloy-2 respectively. This contamination is thought to result from poor process control and is not inherent to the process. Coated and uncoated specimens of reactor-grade zirconium and Zircaloy-2 were exposed to essentially pure hydrogen at 1000°F and 1200°F for two hours. The uncoated specimens

were readily hydrided to greater than 1000 ppm hydrogen. The coated specimens remained at their original hydrogen content of 200 ppm. It was concluded that the Al-aluminized coating offers considerable promise as a hydrogen barrier for zirconium alloys. (auth)

36299 (NMI-TJ-54) THE EFFECT OF ZONE REFINING ON THE PURITY AND MECHANICAL PROPERTIES OF BERYLLIUM SINGLE CRYSTALS. D. F. Kaufman, E. D. Levine, J. J. Pickett, and L. R. Aronin (Nuclear Metals, Inc., West Concord, Mass.). Aug. 7, 1963. Contract AT(30-1)-1565. 32p. (CONF-170-1)

From Conference on the Physical Metallurgy of Beryllium, Gatlinburg, Tenn., Apr.-May 1963.

Chemical analyses and resistance ratio measurements showed that zone refining of beryllium results in large reductions in impurity content. The ultimate level of purity reached is strongly dependent on the purity of the starting material. Critical resolved shear stresses for basal and prismatic slip are found to decrease in a regular manner with decreasing impurity content as measured by resistance ratio. In the purity range studied, the absolute decreases in critical stresses for the two processes are approximately equal. The critical resolved shear stress for prism slip is strongly temperature dependent; critical resolved shear stress for basal slip is almost independent of temperature. Purification by zone refining markedly increases the capacity for basal glide and reduces the rate of work hardening. Fracture still occurs by basal cleavage at room temperature, but at elevated temperatures brittle fracture by cleavage is eliminated. Brittle fracture by cleavage accompanying slip on a single set of prismatic planes is eliminated in crystals purified by zone refining. Addition of iron to zone-refined beryllium results in lattice strengthening as measured by critical resolved shear stress for basal slip. Flow characteristics as measured by work-hardening rate are relatively unaffected. Although the ease of basal glide in zone-refined crystals has so far inhibited the appearance of deformation processes permitting c-axis contraction, it is possible that this same ease of basal glide may improve three-dimensional ductility in polycrystalline material by permitting extensive deformation by shear. (auth)

36300 (NP-13070) RESEARCH PROGRAM RELATED TO VAPOR THERMIONIC CONVERTERS FOR NUCLEAR APPLICATION. Quarterly Progress Report, March 27–June 27, 1963. A. O. Jensen (Electro-Optical Systems, Inc., Pasadena, Calif.). July 30, 1963. Contract NAS 3-2529. 67p. (EOS-3410-Q-3)

The effects of long time at temperature on the surface crystal structure of polycrystalline molybdenum substrates and how these changes in surface crystal structure relate to the performance of cesiated molybdenum emitters for use in cesium vapor thermionic converters for nuclear application are investigated. Vapor deposited tungsten coatings are being fabricated for copper and molybdenum. Calibration and stability data are presented for W/5% Re–W/26% Re thermocouples at 1000 to 1515°C. (N.W.R.)

36301 (ORNL-TM-455) SWAGING OF URANIUM–MOLYBDENUM ALLOY POWDERS CONTAINING 10 TO 15 WT % MOLYBDENUM. S. A. Rabin, A. L. Lotts, and J. P. Hammond (Oak Ridge National Lab., Tenn.). Sept. 11, 1963. Contract W-7405-eng-26. 23p.

Uranium–molybdenum alloy rods containing from 10 to 15 wt % Mo and $^3/_{16}$-in. in diameter were successfully fabricated by hot rotary swaging, followed by machining to remove the protective sheathing (Inconel with molybdenum barrier). Structurally strong rods with densities greater than 95% of theoretical were produced from both calcium-reduced uranium mixed with hydrogen-reduced molybdenum and acid-cleaned, prealloyed shot when reduced in area about 55% at 1050 or 1100°C. Alloy homogeneity was good with prealloyed powders; however, traces of molybdenum-rich, gamma phase persisted in the elemental uranium–molybdenum material after swaging at 1100°C. Swagings embodying hydride uranium or oxide-contaminated prealloyed shot were unsatisfactory because of insufficient consolidation or poor interparticle bonding. (auth)

36302 (TID-17867) METALLOGRAPHIC AND X-RAY OBSERVATIONS OF Pu–C ALLOYS. S. Rosen, M. V. Nevitt, and A. W. Mitchell (Argonne National Lab., Ill.). Nov. 8, 1962. Contract W-31-109-eng-38. 17p. (UAC-7085)

Metallographic, x-ray diffraction, and incipient-melting techniques were used to investigate the Pu–C phase diagram below 50 at.% C and for temperatures between 500 and 1500°C. The variation of lattice parameter with composition for Pu–C alloys is presented and used to define portions of the low-carbon boundary of the PuC phase field. Unique microstructural characteristics are detailed for the $\epsilon Pu + PuC \rightleftharpoons Pu_3C_2$ peritectoid reaction, namely, the preference of the Pu_3C_2 phase to grow as platelets rather than as an interfacial envelope surrounding the PuC reactants. Some aspects of coring in cast alloys containing the monocarbide phase are discussed. (auth)

36303 (TID-17914) THE MECHANISM OF DUCTILE RUPTURE OF METALS CONTAINING INCLUSIONS. J. Gurland (Brown Univ., Providence) and J. Plateau (Institut de Recherches de la Siderugie, St.-Germain-en-Laye, France). [Jan. 23, 1963]. Contract AT(30-1)-2394. 27p.

The role of inclusions in ductile fracture was examined on an experimental and theoretical basis. Microscopic observations showed that inclusions or precipitates are often the source of cracks which lead to ductile rupture. Three different stages may be supposed for this type of ductile rupture: 1) formation of cracks at inclusions, 2) growth of the cracks, and 3) internal striction leading to failure. The major part of the elongation takes place during the second stage. The stresses which are developed around inclusions are described. The elongation to rupture was calculated on the basis of quite simple assumptions, and it is shown that, for a given material, it depends primarily on the volume fraction of the particles. Fair agreement was obtained between the results calculated from the theory and the experimental data on copper-base composite alloys reported by Edelson and Baldwin. (auth)

36304 (TID-19337) CsCl-TYPE COMPOUNDS IN BINARY ALLOYS OF RARE EARTH METALS WITH ZINC AND COPPER. Technical Report No. 17. C. C. Chao, H. L. Luo, and P. Duwez (California Inst. of Tech., Pasadena. W. M. Keck Lab. of Engineering Materials). July 1963. Contracts AT(04-3)-221 and Nonr-220(30). 7p.

Compounds of equiatomic composition of Cu with Sm, Tb, Dy, Ho, Tm, and of Zn with Y, Nd, Sm, Gd, Tb, Dy, Ho, Er, and Tm were found to crystallize into the CsCl (B2-type) structure. The lattice parameters of these compounds vary linearly with the trivalent ionic radii of the rare earth elements. (auth)

36305 (WAPD-270) THE ELECTRICAL CONDUCTIVITY AND THERMOELECTRIC POWER OF URANIUM DIOXIDE. R. A. Wolfe (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Apr. 1963. Contract AT(11-1)-Gen-14. 20p.

The electrical conductivity and thermoelectric power of

nearly stoichiometric uranium dioxide were measured at temperatures from 25 to 1100°C. At temperatures below 800°C this material is a p-type extrinsic semiconductor. The extrinsic conductivity is related primarily to minor deviations from stoichiometry. The carrier mobility in the extrinsic range increases exponentially with temperature, indicating that conduction occurs by the hopping mechanism. The activation energy for hopping motion is 0.13 ev. At temperatures above 800°C the conductivity becomes intrinsic with an energy gap of 1.9 ev. (auth)

36306 (UCRL-10793) DISLOCATION SUBSTRUCTURE IN QUENCHED ALUMINUM SINGLE CRYSTALS (thesis). J. L. Strudel (California. Univ., Berkeley. Lawrence Radiation Lab.). June 1963. Contract W-7405-eng-48. 41p.

Observations were made by transmission electron microscopy of thin foils of high-purity aluminum single crystals quenched from 651°C into water at 0°C. Loops of 250 Å diameter were found lying on (111) planes. Electron diffraction contrast experiments using single crystals of [111] orientation showed that the loops are 99% of the Frank sessile type. Single crystals of [1 1 0] orientation were used to study interactions between glissile dislocations and Frank sessile loops. When a moving dislocation came close to a loop the stacking fault was destroyed and the loop often became attached to the moving dislocation causing it to glide prismatically to the surface of the foil. (auth)

36307 YIELD POINT PHENOMENA IN MAGNESIUM–LITHIUM SINGLE CRYSTALS. R. M. Quinby, J. D. Mote, and J. E. Dorn (Univ. of California, Berkeley). Am. Soc. Metals, Trans. Quart., 55: 149-57(Mar. 1962).

An investigation was conducted on the deformation of single crystals of α solid solution (12.5 at.% Li in Mg) specially oriented for basal slip. Crystals were tested in tension over the range of temperatures between 77 and 645°K. The alloy has a critical resolved shear-stress at least 10 times that of pure Mg. Whereas the critical resolved shear-stress was temperature-dependent below 250°K, it was relatively constant over the higher temperature range. Above 400°K all crystals fractured on the prismatic planes following duplex prismatic slip. Twinning, kinking, and accommodation bending was observed in areas adjacent to subgrain boundaries, and the shear-stress vs shear-strain curves for the crystals were correlated with the various types of deformation markings observed on the surfaces of the strain specimens. The thermally activated deformation mechanism below 250°K probably arises from the dislocation intersection process whereas the higher temperature athermal behavior is thought to be a result of short-range ordering. (auth)

36308 X-RAY ANALYSIS OF TECHNETIUM–MOLYBDENUM ALLOYS. J. Niemiec (Technical Univ., Wrocław, Poland). Bull. Acad. Polon. Sci., Ser. Sci. Chim., 11: 305-9(1963). (In English)

Results obtained from x-ray diffraction studies of 99 phases in Mo–Tc alloys are presented. The following phases were identified: α-primary solid solution bcc structure, β-phase of regular β-W structure, σ-phase of tetragonal structure, and θ-final solid solution of hcp structure. The atomic volumes of the phases were calculated. (M.C.G.)

36309 X-RAY ANALYSIS OF TECHNETIUM BINARY ALLOYS WITH TUNGSTEN AND RHENIUM. J. Niemiec (Technical Univ., Wrocław, Poland). Bull. Acad. Polon. Sci., Ser. Sci. Chim., 11: 311-16(1963). (In English)

In continuation of investigations of the structure of technetium alloys, 12 sintered Tc–W alloys covering the entire composition range were prepared. The W–C system was characterized by the occurrence of the following phases: α-primary solid solution, σ-phase, θ-final solid solution. In studies of Re–Tc alloys, it was found that they present a continuous solid solution after sintering at 1800°C. Lattice parameters and atomic volumes are given. (M.C.G.)

36310 PURIFICATION OF BERYLLIUM BY ZONE FUSION. Bernard Schaub and Gerard Cabane. Compt. Rend., 257: 444-7(July 8, 1963). (In French)

Beryllium bars obtained by fusion under ultravacuum by electron bombardment of foils of electrolytic Be were then purified by floating zone fusion under Ar. Three electrolytic fused salt melts were used. The impurities in the foils from the three melts were determined and compared, and a melt of KCl, LiCl, and $BeCl_2$ gave a slightly superior quality of Be with respect to the concentration of Fe, Mn, and Ni. The floating zone fusion process gives Be bars, after the third pass, that can be bent easily by hand at room temperature, regardless of the quality of the starting material. The impurity concentrations are tabulated. The evolution of the resistivity at room temperature with respect to the resistivity at the temperature of liquid hydrogen is shown. (J.S.R.)

36311 ELASTIC MODULI OF PYROLYTIC GRAPHITE. Emmanuel P. Papadakis and Harold Bernstein (ManLabs, Inc., Cambridge, Mass.). J. Acoust. Soc. Am., 35: 521-4 (Apr. 1963).

The elastic moduli of pyrolytic graphite, a polycrystalline material exhibiting large elastic anisotropy, are measured by the ultrasonic pulse-echo method. In units of 10^{11} dyne/cm^2, they are $c_{11} = 5.21$, $c_{12} = 1.88$, $c_{13} = 1.80$, $c_{33} = 2.58$, and $c_{44} = 0.15$. (auth)

36312 STRUCTURAL AND MAGNETIC CHARACTERISTICS OF $TiFe_2$–$ZrFe_2$ AND $ZrCo_2$–$ZrFe_2$ ALLOYS. E. Piegger and R. S. Craig (Univ. of Pittsburgh). J. Chem. Phys., 39: 137-45(July 1, 1963).

Structures and unit-cell dimensions for a number of alloys of $TiFe_2$–$ZrFe_2$ and of $ZrCo_2$–$ZrFe_2$ were determined at room temperature, and the magnetic properties of alloys of the two systems were investigated over a range of temperature extending from 4 to 650°K. Results for the $TiFe_2$–$ZrFe_2$ system show two terminal phases separated by a two-phase region extending from 56 to 85 mole % $ZrFe_2$. $TiFe_2$ behaves like a strongly paramagnetic substance with a susceptibility that is practically temperature independent, whereas $ZrFe_2$ is ferromagnetic with a Curie temperature of 355°C. The effective moment per iron atom, obtained from the observed saturation magnetization at 4°K, is 1.62 μ_B. The reduced moment in both the $TiFe_2$ and $ZrFe_2$ phases compared to that for elemental iron is attributed to a transfer of charge from Ti or Zr to iron. The $ZrCo_2$–$ZrFe_2$ alloys form a single phase system that approximately obeys Vegard's law. $ZrCo_2$ is found to be fairly strongly paramagnetic at room temperature, while at low temperature it appears to be either very weakly ferromagnetic or paramagnetic with a susceptibility that is field dependent and shows saturation effects. As $ZrCo_2$ is dissolved in $ZrFe_2$, the shapes of the magnetization-temperature curves change in a way that indicates that the destruction of the ferromagnetism occurs over an unusually large temperature interval. The effect is attributed to microscopic variations in the molecular field in the solid solutions. The small values of the observed magnetic moments suggest that in these materials zirconium donates electrons to iron and cobalt. When Fe in $ZrFe_2$ is progressively replaced by Co, the average moment of Co and Fe is observed to decrease initially and to reach a minimum at about 40 mole % $ZrFe_2$. (auth)

36313 MAGNETIC CHARACTERISTICS OF Tb–Y AND Ho–Y SOLID SOLUTIONS. Sidney Weinstein, R. S. Craig, and W. E. Wallace (Univ. of Pittsburgh). J. Chem. Phys., 39: 1449-54(Sept. 15, 1963).

Magnetization-temperature data are presented for temperatures ranging from 4.2 to 300°K for Tb–Y and Ho–Y solid solutions in which the Y content varies from 0 to 90 at. %. Incorporation of Y into the Tb lattice suppresses the tendencies for both ferromagnetic and antiferromagnetic ordering. The former in particular is affected so that alloys containing 70% Tb or less no longer exhibit ferromagnetism in the absence of an applied field. The Néel point (T_N) is lowered when Ho is diluted with Y but the temperature of its lower magnetic transition point (sometimes called its Curie point) is essentially unchanged. T_N^h is observed to vary linearly with composition in both the Tb–Y and Ho–Y systems. The paramagnetic behavior of both systems is in general accordance with that expected on the basis of the simple molecular field picture. The magnetization-temperature behavior of $Tb_{70}Y_{30}$ is anomalous, resembling that of $Dy_{90}Y_{10}$ and $Dy_{95}Y_5$. Under certain circumstances these alloys appear to be magnetically two phase. (auth)

36314 THE SYSTEM THORIUM–GERMANIUM. Allan Brown and J. J. Norreys (General Electric Co. Ltd., Wembley, Eng.). J. Less-Common Metals, 5: 302-13(Aug. 1963). (In English)

An investigation of the Th–Ge system established the formation of the phases Th_3Ge, Th_5Ge_2, ThGe, $ThGe_{1.5}$, $ThGe_2$, and $Th_{0.9}Ge_2$. Crystal structure data for all the phases except Th_3Ge are given. A tentative phase diagram was constructed on the basis of metallographic and x-ray analyses and from melting point determinations. The phase equilibrium and structure results are discussed and compared with corresponding results for the Th–Si and U–Si systems. (auth)

36315 PECULIAR ANOMALIES IN ELECTRICAL RESISTIVITY OF SOME RARE EARTH METALS AT LOW TEMPERATURES. R. V. Colvin and Sigurds Arajs (U. S. Steel Corp., Monroeville, Penna.). J. Less-Common Metals, 5: 337-55(Aug. 1963).

Step-type anomalies in the electrical resistivity between 4 and 5°K found in holmium, erbium, thulium, and lutetium, contaminated with tantalum, are described. The results are discussed in terms of the concept of superconducting filaments formed by tantalum. Some other features of the electrical resistivity (hysteresis effects above critical temperature of tantalum, resistivity minimum) also observed in certain cases are described and are difficult to understand from the viewpoint of a superconductivity substructure. It is possible that in special cases some cooperative magnetic ordering occurs that is responsible for the observed effects. Some experiments, which should clarify the proposed models, are suggested. (auth)

36316 THE HARDNESS AT HIGH TEMPERATURES OF SOME REFRACTORY CARBIDES AND BORIDES. L. M. Fitzgerald (Cavendish Lab., Cambridge, Eng.). J. Less-Common Metals, 5: 356-64(Aug. 1963). (In English)

A new method was used to measure the hardness of material with high melting points at temperatures up to 2000°C. It was found that the materials, although extremely hard at room temperature, generally lose their hardness quite markedly at approximately 1000°C. An exception to this is boron carbide, which retains its extremely high hardness at temperatures quite close to its melting point. Single crystals of TiC appear to retain their hardness at higher temperatures than the polycrystalline form and it is considered that grain boundary weakness, possibly aggravated by porosity, is responsible for the loss of hardness of the polycrystalline specimens at relatively low temperatures. (auth)

36317 POLYGONIZATION IN Mo AND ITS ALLOYS. M. L. Bernshtein, E. L. Demina, E. E. Liberman, and L. G. Chernukha. Metalloved. i Term. Obrabotka Metall., Sb. Statei, No. 5, 49-54(1963). (In Russian)

Cast Mo, Mo powder, and Mo–Zr, Mo–Ti, and Mo–Ti–Zr alloys were cold and hot rolled and annealed at various temperatures. Determination was made of the optimum annealing and deformation temperatures to produce maximum polygonization and of the effect of polygonization on elastic limit, recrystallization temperature, microhardness, and microstructure. The effects of Ti and Zr on polygonization and elastic limit were also investigated. (Rev. Metal Lit., 20: No. 8, Aug. 1963)

36318 ELECTROCHEMICAL PROPERTIES AT THE CURIE POINT. J. K. Prall and P. R. Doidge (Battersea Coll. of Tech., London). Nature, 199: 800(Aug. 24, 1963).

Preliminary studies on Cd showed that it exhibits maximum electropositivity in the Curie point region. The apparatus used is described and data are presented graphically. (C.H.)

36319 LIFE OF ZIRCONIUM VESSELS DURING CONTINUOUS STEEL CASTING. V. M. Strelets, N. V. Pitak, A. I. Kulik, and M. S. Logachev. Ogneupory, No. 4, 163-5 (1963). (In Russian)

Zirconium vessels were manufactured from Zr powder and additions of clay and sulfite-alcohol binder by pressing, drying, and roasting in a tunnel furnace at 1540°C. The refractoriness, porosity, specific gravity, wear resistance, and oxidation characteristics of the vessels were determined by using them as intermediate vessels in continuous casting of killed steel. (Rev. Metal Lit., 20: No. 8, Aug. 1963)

36320 ELECTRICAL CONDUCTIVITY IN LEAD TITANATE ZIRCONATE CERAMICS. R. Gerson and Hans Jaffe (Clevite Corp., Cleveland). Phys. Chem. Solids, 24: 979-84(Aug. 1963). (In English)

Ferroelectric lead titanate zirconate ceramics prepared by sintering in air are found to have p-type conductivity, believed to result from an excess of lead vacancies. Donor substituents for lead, titanium, or zirconium reduce the conductivity by electron-hole compensation, but n-type conductivity is not observed and is probably prevented by the formation of lead site vacancies. The data supporting this view are presented. These include observations on the effect of donor and acceptor doping and of oxygen pressure during sintering on resistivity, and measurements of thermal emf. A comparison is made between effects observed in lead titanate zirconate ceramics and those in barium titanate, which can have high n-type conductivity at room temperature after doping, and in barium zirconate. (auth)

36321 ON THE DEFORMATION INDUCED INTERNAL FRICTION PEAKS IN NIOBIUM. R. De Batist (CEN, Mol, Belg.). Phys. Status Solidi, 3: 1475-9(1963). (In English)

The activation energies and attempt frequencies for the deformation-induced damping peaks in niobium were determined. For the α peak, these were found to be 0.28 ± 0.01 ev and $(2.8 \pm 1.8)\ 10^{12}\ s^{-1}$ from the variation of peak temperature with frequency and using all experimental data available. For the β peak, these parameters were estimated using strain recovery experiments performed during the warm-up after plastic deformation at liquid nitrogen

temperature. A value of 0.51 ev was found for 10^{12} s^{-1} and 0.48 ev for 10^{11} s^{-1}, to be compared with values of 0.47 ev and about 10^{11} s^{-1} obtained by Chambers and Schultz from the shift of peak temperature with frequency. The width of the α peak is shown to be consistent with a relaxation process having a single attempt frequency, and a distribution of activation energies. Assuming a square distribution of width ΔH about H, it was found that $\Delta H/\overline{H} \approx 0.10$. (auth)

36322 GRAPHITE: QUALITY ASPECTS IN RELATION TO USE. Edward A. Smith. Sci. Lubrication (London), 15: 16-19; 22-5(May 1963).

A review on graphite attempts to bring certain basic properties of graphite to use-properties, and to illustrate the need for selection of quality for particular applications. Special attention is given to wide variations in properties of natural and electric furnace, or synthetic graphite. (P.C.H.)

36323 SOME OBSERVATIONS ON THE METASTABLE PHASES IN URANIUM BASE RUTHENIUM ALLOYS. D. K. Chaudhuri and K. Tangri. Trans. Indian Inst. Metals, 15: 214-19(1962).

The results of metallographic and x-ray investigations on metastable phases produced in gamma quenched U–Ru alloys are reported. Distorted orthorhombic structure, microstructure, and hardness as affected by alloying content were investigated. (Rev. Metal Lit., 20: No. 8, Aug. 1963)

36324 THERMAL TREATMENT OF NIOBIUM. G. V. Zakharova and L. P. Zhorova. Tsvetn. Metal., No. 5, 53-8 (May 1963). (In Russian)

Annealing effects on Nb gas content following melting in an arc furnace, shock ductility of hot niobium, and mechanical properties of cold rolled sheets in tungsten and graphite furnaces were studied. (R.V.J.)

36325 NEW DATA ON In–Se CONSTITUTION DIAGRAM. G. K. Slavnova, N. P. Luzhnaya, and Z. S. Medvedeva. Zh. Neorgan. Khim., 8: 1199-1203(May 1963). (In Russian)

Constitution diagrams were constructed for a wide range of In–Se concentrations based on the thermal microstructure analyses. A compound of In_5Se_6 with incongruent melting at 660 ± 10° and polymorphous transformation $\alpha \rightleftharpoons \beta$ 550 ± 10° was found. Microstructure and microhardness of α-In_2Se_3, α-In_5Se_6, InSe, and In_2Se were determined. The microhardness of α-In_2Se exceeds that of α-In_2Se_3 and InSe by 5 to 6 times and is about 300 times as high as that of metallic In. (R.V.J.)

36326 INVESTIGATIONS OF ALUMINUM-RICH Al–Mn–Ce ALLOYS. O. S. Zarechnyuk, I. F. Kolobnev, and M. Yu. Teslyuk (Lvov State Univ.). Zh. Neorgan. Khim., 8: 1668-72(July 1963). (In Russian)

X-ray phase and microstructure analyses of 166 alloys indicated the isothermal cross section of aluminum in Al–Mn–Ce alloys at 500°C. Investigations of Al–Mn–Ce alloys with 5 wt % Ce showed that solid solution with aluminum base (ω phase) does not contain cerium. All alloys were heterogeneous. The lattice constants (a) of solid solutions with Al (ω phase) base in ternary alloys at 600 to 500° are presented for alloys containing 1 and 5 wt % Ce and 0 to 2.4 wt % Mn. (R.V.J.)

36327 PHYSICO-CHEMICAL PROPERTIES OF Al–Si–Ce WITH 0 TO 73 WT % Ce. L. N. Altunina, E. I. Gladyshevskii, O. S. Zarechnyuk, and I. F. Kolobnev (Lvov State Univ). Zh. Neorgan. Khim., 8: 1673-7(July 1963). (In Russian)

X-ray phase analysis of microstructure and microhardness of 85 alloys determined the isothermal cross section of the ternary Al–Si–Ce system (0 to 73 wt % Ce) at 400°C. It was found that in addition to Si and Al_4Ce a ternary compound x and solid solution of Al in $CeSi_2$ compound are in equilibrium with the aluminum-base solid solutions. Approximate composition of the x compound is 35 at. % Al, 45 at. % Si, and 20 at. % Ce (19 wt % Al, 25 wt % Si, and 56 wt % Ce). The x-ray diffraction analysis showed that $Ce(Si,Al)_2$ has an α–$ThSi_2$ type structure. The maximum Al content in solid solution $Ce(Si,Al)_2$ is 20 to 22 wt % indicating that Al atoms replace 85 to 90% Si. (R.V.J.)

36328 HYDRIDATION OF CERIUM–ALUMINUM ALLOYS. V. I. Mikheeva, Z. K. Sterlyadkina, and A. A. Chertkov (Kurnakov Inst. of General and Inorganic Chemistry, Academy of Sciences, USSR). Zh. Neorgan. Khim., 8: 1710-14(July 1963). (In Russian)

Additions of up to 25 at. % Al to Ce increases the induction period and hydration time of cerium. A maximum hydrogen absorption by aluminum is described by an empirical formula $CeH_3 \cdot 0.163$ AlH (at 14 at. % Al). Hydridation products of cerium and aluminum liberate H in two stages, which are not as well defined as in the case of cerium trihydride. (R.V.J.)

36329 HYDRIDATION OF CERIUM ALLOYS WITH MAGNESIUM AND ALUMINUM. V. I. Mikheeva, Z. K. Sterlyadkina, and A. A. Chertkov (Kurnakov Inst. of General and Inorganic Chemistry, Academy of Sciences, USSR). Zh. Neorgan. Khim., 8: 1715-21(July 1963). (In Russian)

Hydridation of Ce–Mg–Al alloy at room temperature and normal pressure was studied with an alloy containing 70 to 90 wt % Ce. Maximum of hydrogen absorption was in the region of 5 to 10% Al and 35 to 60% Mg. An increased amount of Al in the Ce–Mg system contributes to increased hydrogen absorption. The induction period of hydridation is sharply reduced in alloys with 5 to 15% Al and total Mg–Al content above 50% and the reaction becomes less dependent on hydrogen purity. The presence of Al also reduces the temperature of Ce decomposition from 1080 to 1010°C. (R.V.J.)

36330 SAMARIUM, EUROPIUM, AND YTTERBIUM BERYLLIDES OF ABe_{13} COMPOSITIONS. N. N. Matyushenko, V. N. Karev, and L. F. Verkhorobin (Inst. of Physics and Tech., Academy of Sciences, Ukrainian SSR). Zh. Neorgan. Khim., 8: 1788(July 1963). (In Russian)

Intermetallic compounds of Sm, Eu, and Yb beryllides of ABe_{13} composition were prepared by reduction of oxides in a (0.3 mm) beryllium-coated crucible. X-ray pictures taken with copper emission from plane specimens indicated cubic structure phases. The lattice periods were equal to 10.28 ± 0.02A, 10.288 ± 0.002 Å, and 10.19 ± 0.02 Å for $SmBe_{13}$, $EuBe_{13}$, and $YbBe_{13}$, respectively. (R.V.J.)

36331 COLUMBIUM AND TANTALUM. Frank T. Sisco and Edward Epremian. New York, John Wiley and Sons, Inc., 1963. 635p.

A collection of 14 papers on the physical and mechanical properties of Nb and Ta and methods of extraction, consolidation, fabrication, joining, alloying, and metallography are included. Analytical chemistry and formation of chemical compounds of Nb and Ta are also discussed. (Rev. Metal Lit., 20: No. 7, July 1963)

36332 PHYSICAL AND MECHANICAL PROPERTIES OF COLUMBIUM AND TANTALUM AND THEIR ALLOYS. R. W. Fountain and C. R. McKinsey. p.198-303 of "Columbium and Tantalum." New York, John Wiley and Sons, Inc., 1963.

A review is presented on crystallographic, atomic and

nuclear, thermal, electrical, optical, and electronic properties; elastic, tensile, creep, and fatigue properties as affected by temperature; impurity content and other variables; recrystallization, diffusion, and annealing behavior of Nb and Ta. (Rev. Metal Lit., 20: No. 7, July 1963)

36333 DISILICIDE BASE REFRACTORY METAL COATINGS IN SPACE ENVIRONMENT. Sidney I. Bocarsly (Lockheed-California Co., Burbank). 16p. (CONF-59-3)

From American Societies for Metals, Western Metal Congress, Los Angeles, Mar. 1963.

Studies of probable effects of space environment exposure of Durak "B" (a Chromizing Corp. proprietary disilicide coating) coated Mo are described. It was concluded that, in a high-temperature environment, solar radiation will not affect the material system. Sputtering will not cause a structural problem, but it may cause a change in optical properties. Meteoroids may cause coating spalling and minimum to possibly total failure. Some protection system will probably be necessary. Vacuum will cause some coating evaporation. The rate will be temperature-dependent and probably of a low order. The possible problem area is that the evaporation appears to occur preferentially at crack sites. Ionized nitrogen and hydrogen may react with the coating and change physical or mechanical properties. (A.G.W.)

36334 VAPORIZATION OF MHD WALL MATERIALS UNDER CONVECTIVE FLOWS AT HIGH TEMPERATURES. E. V. Somers and R. L. Hundstad (Westinghouse Research Labs., Pittsburgh). 19p. (CONF-24-9)

From Engineering Aspects of Magnetohydrodynamics Symposium, Berkeley, Calif., Apr. 1963.

Calculation of erosion of MHD duct linings depends on knowledge of the dimensionless convective correlations for magnetohydrodynamic flows, the vapor pressure of the material, and the extent of wall roughness. Convective transport under conditions of turbulent magnetohydrodynamic flow remains to be evaluated. Data on the vapor pressure of high temperature MHD materials are being accumulated. Wall roughness effects with magnetohydrodynamic flows are unavailable; estimates for future design use will probably employ the non-MHD information presented by Moody (Trans. ASME 66, 671-84(1944)). Interpretation of the experimental data for convective evaporation of MgO and ZrO_2 depends on the values of the vapor pressures assumed for the magnesia and zirconia. Grouping together of the dimensionless convective-flow parameters computed from all the experimental data and reasonable agreement of these data with analytical results have indicated the vapor pressure data selected for magnesia and zirconia to be accurate. Design use of available convective transport formulations for ablation of duct walls is reasonable. Increases by factors of 3 to 5 in friction and convective losses due to wall roughness may well be present in large MHD generators. (auth)

Radiation Effects

Refer also to abstract 35792.

36335 (AD-287146) THE EFFECT OF TWO Mev DEUTERON AND PROTON RADIATION ON THE CONDUCTIVITY IN N-TYPE GERMANIUM DENDRITE CRYSTALS (thesis). Ralph H. Jacobson (Air Force Inst. of Tech., Wright-Patterson AFB, Ohio). Aug. 1962. 55p. (GA/Phys/62-9)

N-type germanium crystals, both dendrites and ordinary crystals, were irradiated with 2-Mev deuterons and protons in order to find if any differences in the effects on conductivity of radiation exist between the two types of crystals. The electron reduction rate and the hole production rate was found to be greater by a factor of approximately 2 in the dendrite crystals. The results indicated the formation of acceptor levels associated with the surface. These levels are relatively more important in the more perfect surfaces of the dendrites. A demonstration, showing the possibility of making electronic devices by a simple radiation process, was also conducted. (auth)

36336 (AD-295101) DESIGN CRITERIA FOR RADIATION-RESISTANT FLIGHT CONTROL SYSTEMS FOR AEROSPACE VEHICLES. Progress Report, May 1–May 31, 1962. (Northrop Corp. Northrop Space Labs., Hawthorne, Calif.). Contract AF33(657)-7851. 5p.

Study was continued on the determination of flight control systems, definition of radiative environment, determination of radiation penetration through satellite walls, determination of radiation damage criteria, and determination of radiation effects on flight control system. (auth)

36337 (BNL-6558) DI-INTERSTITIAL ANNEALING DURING THE FIRST NEUTRON IRRADIATION OF GRAPHITE: THE MOBILITY OF C_2. Donald G. Schweitzer (Brookhaven National Lab., Upton, N. Y.). [1962]. Contract [AT(30-2)-Gen-16]. 14p.

Radiation and annealing mechanisms for dimensional and c-axis changes in which the di-interstitial can be mobile at any or all temperatures above absolute zero are shown to be concordant with earlier work used to determine the migration energy of single interstitials and the absolute rate of displacing atoms in graphite. The mechanisms account for the stability of c-axis and dimensional changes with time in the absence of irradiation and with observed c-axis annealing at room temperature following irradiation at lower temperatures. The relative magnitudes of rate constants for di-interstitial trapping and annealing reactions during irradiation are discussed. (auth)

36338 (BNL-6560) RADIATION DAMAGE IN GRAPHITE. IV. INTERSTITIAL REACTION KINETICS: COMPARISON OF THEORY AND EXPERIMENT. Donald G. Schweitzer (Brookhaven National Lab., Upton, N. Y.). [1962]. Contract [AT(30-2)-Gen-16]. 16p.

Interstitial cluster distributions and radiation formation and decomposition reactions are identified by fitting experimentally determined kinetic equations with calculations for consecutive reaction systems. Rate constants for the radiation decomposition of interstitial complexes are temperature independent and depend only on the neutron flux and the cross section of the complex. Rate constants for the radiation formation reactions of interstitial complexes all have the same temperature dependence. The results are consistent with the model described in other work in which immobile interstitial complexes are assumed to interact by addition and removal of mobile single interstitials. The total number of carbon atoms in the steady-state concentrations of interstitial complexes is the same in different species. The initial G/R function described in the preceding paper corresponds to reirradiations when single interstitials are not in steady state. The single interstitials reach steady state at the same time that the last of the intermediate species in the chain reach steady state. The second G/R function discussed in the previous paper describes dimensional changes when both single interstitials and interstitial complexes are in steady state. Anomalous radiation contraction and recovery hysteresis effects observed after reirradiations of 100 to 140 Mwd occur during the transition from non-steady state to steady

state. The absence of annealing in the temperature intervals found in earlier discrete annealing experiments may be due to structural rearrangements (during reirradiations) of energetically unfavorable configurational isomers. (auth)

36339 (CEND-158) IRRADIATION TESTING OF CERAMIC FUELS. Summary Report. G. Zuromsky and W. P. Chernock (Combustion Engineering, Inc. Nuclear Div., Windsor, Conn.). Sept. 1962. Contract AT(30-1)-2936. 204p. (NYO-2998)

A research program was completed on the composition limits for single-phase face-centered cubic crystal structures in the ZrO_2-rich region of $UO_2-CaO-ZrO_2$ and in the CeO_2-rich end of UO_2-CeO_2, on the fabrication of high-density pellets from these cubic compositions of both systems, on the properties of these cubic compositions, and on the irradiation stability of these compositions. Phase studies are reported that confirm the occurrence of cubic regions in both UO_2-ZrO_2-CaO and UO_2-CeO_2. The properties measured include thermal conductivity, thermal performance testing, melting points, and corrosion in water and steam. Progress in the irradiation program is described. (D.L.C.)

36340 (CONF-11-8) UO_2 FUEL ROD PERFORMANCE WITH A MOLTEN CENTRAL CORE. M. F. Lyons, R. C. Nelson, T. J. Pashos, R. L. Straley, and B. Weidenbaum (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.). [1962]. Contract AT(04-3)-189. 41p.

From American Nuclear Society 1962 Winter Meeting, Washington, D. C., Nov. 1962.

An experimental program has been undertaken to explore the feasibility and limits of UO_2 fuel rod operation with a molten central core. Three UO_2 pellet fuel assemblies were irradiated at high thermal performance levels, under pressurized water conditions, in the GETR. The fuel rods operated with 0.565 OD peak surface heat fluxes ranging from approximately 600,000 to 1,100,000 Btu/hr-ft^2. UO_2 central melting occurred in the fuel rods operating above 600,000 Btu/hr-ft^2 heat flux and axial relocation of both fuel and fission products was evident in the higher thermal performance fuel rods. Ten of the twelve fuel rods irradiated exhibited severe clad swelling in the peak heat flux zone, with a maximum diameter increase in one fuel rod of 0.073 inch. The mechanism for clad swelling has been identified as the UO_2 volume expansion on melting. A special test assembly was fabricated incorporating internal free volume in the fuel to accommodate the UO_2 expansion. Short time irradiation of this assembly at high thermal performance conditions produced negligible clad swelling. The assembly has been returned to the loop for a 25-day irradiation cycle. Continued freedom from swelling in this assembly following extended irradiation will permit resumption of the original program irradiation schedule. A final maximum thermal performance pellet fuel assembly remains to be irradiated. This assembly contains fuel rods to operate at peak surface heat fluxes in the range of 1.2 to 1.3 $\times 10^6$ Btu/hr-ft^2. Following fuel rod modifications similar to that in the special test assembly above, this assembly irradiation will be undertaken and continued to high burnup. The target burnup for the assembly is 20,000 Mwd/t. An identical sequence of assembly irradiations is scheduled using compacted powder UO_2 fuel rods. (auth)

36341 (CONF-39-86) FISSION GAS RELEASE FROM SINGLE CRYSTAL UO_2 DURING IRRADIATION. R. M. Carroll (Oak Ridge National Lab., Tenn.). [1962]. Contract W-7405-eng-26. 4p.

From American Nuclear Society 9th Annual Meeting, Salt Lake City, June 1963.

Results are reported briefly of experiments on the mechanism of fission gas release from irradiated single-crystal UO_2 slabs. The fission gases were found to emerge by two basic processes: a temperature-independent process, and a temperature-dependent process with a threshold temperature of ~600°C and an activation energy of 50 kcal/mole. The proportions of isotopes in the fission gas are the same for both processes. The rate of fission-gas release decreased with burnup to a stabilized value after 4 months of irradiation. The temperature-independent process was directly proportional to the fission rate whereas the temperature-dependent process had no correlation with fission rate. The results suggest that the fission gas collects at defects just beneath the crystal surface, and that the release behaves as if it originates from a totally filled layer beneath the surface, causing the release to be independent of the amount of gas beneath the layer. (D.L.C.)

36342 (CONF-39-89) UO_2 FUEL ROD OPERATION WITH GROSS CENTRAL MELTING. M. F. Lyons, R. C. Nelson, T. J. Pashos, and B. Weidenbaum (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.). May 2, 1963. Contract AT(04-3)-189. 4p.

From American Nuclear Society 9th Annual Meeting, Salt Lake City, June 1963.

EPT-12, a fuel assembly of four rods containing hollow UO_2 pellets clad in Zircaloy-2, is being irradiated in the GETR pressurized-water loop at extreme thermal conditions to produce gross central melting. The peak surface heat flux of the maximum power rod is 1.4 $\times 10^6$ Btu/hr-ft^2. More than 70% of the UO_2 cross section is molten, and the thickness of the unmelted UO_2 rim adjacent to the cladding is ~40 mils. The assembly has attained a burnup of 5,300 Mwd/Te and 23 power cycles. Interim examination of the fuel assembly at the 5,300 Mwd/Te burnup level showed the rods to be identical to the pre-irradiation conditions. The irradiation results are tabulated along with those for earlier fuel assemblies. (D.L.C.)

36343 (EGG-B-2462) ANALYSIS OF EXPERIMENTAL RADIATION EFFECTS DATA. Report No. 4 (Final), June 1, 1961–May 31, 1962. John L. Vidrine (Edgerton, Germeshausen and Grier, Inc., Boston). July 31, 1962. 91p.

The data obtained from the radiation effects monitoring system employed at Godiva II, Triga, and KEWB on a previous contract were reduced and analyzed. On the basis of plots of the experimental data obtained from the original magnetic tape records, an attempt was made to develop a suitable phenomenological expression for the effects of a pulsed nuclear environment on the I_{co} and H_{FE} characteristics of the selected semiconductor devices tested. Expressions were derived that appeared to satisfy the conditions upon the analysis of the experimental I_{co} and H_{FE} data. When subjected to mathematical reduction the expressions proved to be plausible from the standpoint of the physics involved. The results were entirely satisfactory on the basis of a phenomenological model. (auth)

36344 (GA-3616) TRANSIENT RADIATION EFFECTS ON COAXIAL CABLES. Special Technical Report. G. R. Hopkins, A. L. A. Weiman, and D. E. Willis (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Dec. 18, 1962. Contract DA-36-039-SC-89196. 43p. (AD-295486)

An investigation into the radiation effects of gamma and neutron radiation on polyethylene coaxial cable was

started. By a series of tests made in the General Atomic TRIGA Mark F reactor, individual effects due to gamma, fast, and thermal neutron flux were separated and analyzed. Gamma radiation produces a current nearly proportional to incident flux with the central wire at a negative potential. Thermal neutron flux also produces a nearly proportional signal but with the central wire going positive. Fast neutron flux produces a positive-going signal having two components. One component is proportional to flux; the other produces a very large initial signal but saturates quickly. Saturation occurs as integrated fast neutron flux increases and is not time dependent. Varying amounts and types of shielding provided large changes in relative components of flux, both with pulsing and steady-state modes of operation. The data were analyzed for each type of radiation. Although the effects were analyzed in some detail, more investigation is required to supply more accurate numbers. Special experiments should provide clues as to which of several possible mechanisms are involved. (auth)

36345 (GEMP-26A) HIGH-TEMPERATURE MATERIALS PROGRAM, PROGRESS REPORT No. 26, PART A. (General Electric Co. Advanced Technology Services, Cincinnati). Aug. 16, 1963. Contract AT(40-1)-2847. 28p.

Radiation effects of fast neutrons on the physical and mechanical properties of BeO and BeO—5 wt % MgO are studied. (T.F.H.)

36346 (HW-SA-2925(Rev.)) EFFECT OF LOW COMPRESSIVE STRESSES ON RADIATION-INDUCED DIMENSIONAL CHANGES IN GRAPHITE. W. C. Morgan (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). July 23, 1963. Contract AT(45-1)-1350. 20p. (CONF-73-13)

From 6th Biennial Conference on Carbon, Pittsburgh, June 1963.

Samples of five nuclear-grade graphites were irradiated under constant compressive stresses of 150 and 300 psi. Length changes of the stressed samples are compared with length changes of unstressed control samples, irradiated in the same assembly. Results obtained at 625°C and for exposures up to 6500 Mwd/at. in a Hanford irradiation facility are presented. Additional data on one nuclear-grade graphite, irradiated under 100 psi constant tensile stress, are included. (auth)

36347 (NARF-62-18P) NARF FINAL PROGRESS REPORT, OCTOBER 1, 1961 THROUGH SEPTEMBER 30, 1962. (General Dynamics/Fort Worth. Div. of General Dynamics Corp., Fort Worth, Tex.). Contract AF33 (657)-7201. 396p. (AD-412780; FZK-9-184)

Progress is reported on work conducted in basic nuclear research and experimental radiation-effects testing at the Nuclear Aerospace Research Facility: to acquire and evaluate basic data from theoretical and experimental studies; to formulate the evaluated data into nuclear design criteria; to convert the nuclear design criteria into an easily useable form for nuclear aerospace vehicle designers; and to publish and disseminate the converted design criteria. The work is discussed in terms of shielding research, radiation effects on electronic equipment and materials, radiation effects on nonmetallic materials, fundamental radiation-effects studies, and special irradiation experiments. (B.O.G.)

36348 (NYO-10593) PARAMAGNETIC RESONANCE ABSORPTION OF GAMMA IRRADIATED SYNTHETIC ZEOLITES. Dennis N. Stamires and John Turkevich (Princeton Univ., N. J. Frick Chemical Lab.). Aug. 1963. Contract AT(30-1)-1158. 35p.

The effect of gamma irradiation of synthetic zeolites was studied. Sodium X and sodium Y zeolites and also decationated samples prepared from these were irradiated in vacuum at room temperature with doses up to 20 megaroentgens. Two types of EPR signals were obtained. For the sodium Y and the sodium X zeolite a single line signal X_1 was found. It was 38.4 gauss wide with g = 2.0200 indicating that it is a hole; its intensity followed the Curie law. Heating above 350°C caused the signal to disappear. The signal was decreased by oxygen gas but the effect was reversible. Saturation does not take place with irradiation up to 14 megaroentgens. A pink coloration was also produced, but its behavior did not parallel that of the X_1 signal. For the decationated Y zeolite a six lined EPR signal was obtained by radiation. The separation between the lines was 5 gauss and the center of this signal was at g = 2.0017. Its intensity was independent of temperature, and the signal annealed at about 500°C. The signal is not affected by oxygen and its intensity saturates at an exposure of 3 megaroentgens; no coloration was observed. For partially decationated sites both X_1 and X_2 signals were observed. The X_1 signal is interpreted to be a hole located on the oxygen of the lattice, while the X_2 is assumed to be due to an electron located near the Al^{27} nucleus that was decationated. (auth)

36349 (SCC-18) CHEMICAL ADDITIVES—GRAPHITE. Final Report, January 1, 1962–January 1, 1963. W. E. Parker and R. W. Marek (Speer Carbon Co. Research Lab., Niagara Falls, N. Y.). For General Electric Co. Hanford Atomic Products Operation, Richland, Wash. Contract AT(45-1)-1350, Subcontract DDR-136. 37p.

To explore the effects of chemical additives on radiation contraction of graphite, a series of experimental graphites were prepared. Lacking neutron radiation exposure data, results were interpreted in terms of densification and volume contraction during processing. To extend knowledge on additive effects, sample sets were prepared in which graphitizable filler-nongraphitizable binder (phenolformaldehyde resin) and nongraphitizable filler (fluid coke)-graphitizable binder combinations were used. Iron oxide was shown to be an effective densifier for graphitizable filler-binder combinations, but was not useful when either component was nongraphitizable. Nickel oxide was found to be an active densifier for fluid coke-pitch mixes but was ineffective in the formulation containing phenolformaldehyde resin binder. A study of the propensity of various additives to form carbides led to the hypothesis that densification resulted from a transitory formation on a cementite form of the carbide. (auth)

36350 (SCR-688) METHODS OF PREDICTING THE PERFORMANCE OF SEMICONDUCTOR ELECTRONIC CIRCUITS AND SYSTEMS IN A NUCLEAR ENVIRONMENT. S. C. Rogers (Sandia Corp., Albuquerque, N. Mex.). July 1963. Contract [AT(29-1)-789]. 10p. (CONF-185-1)

From Institute of Environmental Sciences Meeting, Los Angeles, Apr. 1963.

The performance of electronic circuits and systems in a radiation environment can be determined if the radiation induced component changes are known and if system performance as a function of component changes can be determined. The most economical way of determining alterations of system performance caused by radiation combines analysis with an experimental technique intended for laboratory use. The analytical method requires that the performance of the system be expressed mathematically in terms of component performance. These equations are then solved using component parameters appropriate

to discrete radiation levels. This approach also can be used to determine the probability of system failure as a function of radiation exposure. The experimental technique involves measuring system performance after substituting radiation-degraded components into it. Although this latter technique only yields the radiation levels for zero and 100% probability of failure, it is a simple and powerful tool. Exposing a system to radiation in order to determine failure levels or failure probabilities is not practical because the large variations normally encountered in semiconductor device parameters may cause failure to occur over a large range of radiation exposure levels. Therefore, a few observations on a specific system are not a reasonable basis for predicting radiation performance of similar systems. (auth)

36351 (TID-17503) EFFECT OF ACCEPTOR IMPURITIES ON THE RADIATION TOLERANCE OF P-TYPE SILICON. Leslie Vadasz and D. Navon (Transitron Electronic Corp., Wakefield, Mass.). [Oct. 1962]. For Sandia Corp., Albuquerque, N. Mex. Contract [AT(29-1)-789]. 19p. (SCDC-2927)

The rate of introduction of damage centers in p-type silicon due to 2 Mev electron bombardment was studied. This damage center is known to be responsible for the $(E_v + 0.3_{ev})$ energy level in the forbidden band. It is found that the rate of introduction of damage sites depends on the initial impurity content of the silicon. Experimental evidence shows a primary dependence on acceptor-type impurities present. The results indicate however that other impurities, such as oxygen and tin, can play a role in the mechanism of this damage formation, especially when the silicon contains few acceptors. It is suggested that a vacancy-interstitial pair formed as a result of bombardment will form a stable damage site by being trapped at an impurity site. (auth)

36352 (USAERADL-TR-2292) NUCLEAR PULSE EFFECTS IN CABLES. Kurt Ikrath and Randolph Constantine (Army Electronics Research and Development Lab., Fort Monmouth, N. J.). Aug. 1962. 62p. (AD-287889)

An equivalent circuit for a piece of cable is developed, and the differential equations of this circuit are solved under the conditions of a transient burst of nuclear radiation and under various ranges of cable bias voltage. Graphs of representative cases are presented and compared to experimental results. A method of solving for the transient change in cable parameters is given, and sample calculations are shown. (auth)

36353 (WAPD-TM-351) INTERNAL ZIRCONIUM HYDRIDE FORMATION IN ZIRCALOY FUEL ELEMENT CLADDING UNDER IRRADIATION. J. M. Markowitz (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). May 1963. Contract AT(11-1)-Gen-14. 47p.

Extensive precipitation of zirconium hydride within the cladding of Zircaloy clad fuel element specimens operated in pile with defects, either deliberate or unintentional, was observed during post irradiation examinations. Generally, the hydride was found near the clad exterior in accordance with the expected results of thermal diffusion; however, in certain cases dense deposits are found at the interior or hot surface. The latter phenomenon was analyzed, and it was shown that while normally hydrogen diffuses thermally to the cold surface, an exceptionally high internally applied flux of hydrogen can cause hydriding at the hot surface. A procedure for calculating the magnitude of the critical flux just sufficient to maintain internal hydride was presented. By applying this criterion to the rate of hydrogen production which could be calculated from several processes possible in the fuel clad gap, it was determined that of all mechanisms for hydrogen production considered for those cases when hydride was precipitated at the hot surface, only the radiolytic decomposition of water into hydrogen and hydrogen peroxide could provide the required rate. It was shown that all peroxide oxygen can be absorbed by the UO_2 fuel at appropriate rates without excessive increase in the O/U ratio. However, the radiolytic mechanism as presently understood is incomplete, because it predicts internal hydriding under thermal and geometric conditions experienced by actual specimens in which no internal hydriding was observed. It was shown that the time to failure for defected specimens whose failure cannot be attributed to internal hydriding was generally shorter than that which would be predicted from corrosion hydrogen pickup to a reasonable tolerance level (250 ppm) established from mechanical property considerations. (auth)

36354 THERMAL STRESS IN SPHERICAL CONCRETE SHIELDING ON ACCOUNT OF RADIATION ABSORPTION. K. Sayar and J. Seetzen (Technische Hochschule, Hanover). Bautechnik, 39: 7-11(Jan. 1962). (In German)

Concrete shielding for reactors can be too highly stressed by the energy absorption of the radiation and the heat stress thereby produced. This makes necessary the computational follow-up of the temperature and the heat stress. The determination of the heat source distribution as a result of radiation absorption in the concrete shield was first explained. The heat source distribution can be represented by e functions. The temperature distribution and the heat stresses in a spherical concrete shield were derived in closed form by consideration of a cooling within the shield. This was followed numerically in two types of concrete, a gravel and hematite concrete. The modification of the heat stresses by a cooling system and through introduction of a thermal shield was given for the hematite concrete. (tr-auth)

36355 NEUTRON-INDUCED EFFECTS IN SEMICONDUCTORS. L. G. Penhale (Royal Military Coll. of Science, Swindon, Eng.). Intern. J. Appl. Radiation Isotopes, 14: 305-25(Aug. 1963). (In English)

The sensitivity of the electrical properties of semiconductors to small changes in lattice order, such as those introduced by radiation damage, renders them useful for the investigation of the effects of radiation in solids. The effect of neutron irradiation is specifically considered, since this causes bulk damage in contrast to the pronounced surface effects observed with charged-particle irradiation. The introduction of impurity atoms in the crystal lattice by transmutation as a consequence of inelastic collision is also considered, and the most likely transitions are presented. Radiation damage, both on the macroscopic and the microscopic scale, is discussed, together with the electrical properties affected. Experimental results for neutron irradiation of germanium, silicon, and indium antimonide are reviewed. The electronic behavior of semiconductors after irradiation may be deduced by considering the energy levels introduced by radiation-produced defects into the normally forbidden energy gaps of the wave-mechanical electronic band structure model of semiconductors and insulators. Energy-level diagrams, after neutron irradiation, are constructed from the data for germanium and silicon. (auth)

36356 RADIATION EFFECTS ON CERTAIN PROPERTIES OF KCl–KBr SOLID SOLUTIONS. V. V. Kutsepalenko and I. Ya. Melik-Gaikazyan (Tomsk Polytechnic Inst.,

USSR). Izv. Vysshikh Uchebn. Zavedenii, Fiz., No. 3, 15-17 (1963). (In Russian)

Electron and γ irradiation improved the yield, microhardness, and electric conductivity of KCl and KBr monocrystals. The improvements were more pronounced in KCl than in KBr crystals. Irradiation of solid solutions of KCl–KBr did not alter their properties, confirming a postulation on the higher radiative stability of solid solutions in comparison to pure components. (R.V.J.)

36357 X-RADIATION EFFECTS ON DIELECTRIC PROPERTIES OF QUARTZ. G. I. Potakhova (Tomsk State Univ., Siberian SSR). Izv. Vysshikh Uchebn. Zavedenii, Fiz., No. 3, 71-5(1963). (In Russian)

Studies of x-radiation effects on dielectric losses in monocrystalline, molten, and thin crystal quartz showed that at low frequencies the angle of dielectric loss increases. Moreover, the tgδ losses are higher for monocrystalline quartz than for molten or thin crystal quartz. (tr-auth)

36358 TEMPERATURE MEASUREMENTS ON SPECIMENS IRRADIATED BY PROTON BEAMS IN AIR. I. G. Berzina and L. S. Sokolov (Tomsk Polytechnic Inst., USSR). Izv. Vysshikh Uchebn. Zavedenii, Fiz., No. 3, 123-6(1963). (In Russian)

Remotely controlled thermocouples were used for measuring the temperature of proton irradiated KCl and NaCl crystals as a function of irradiation time. Measurements on 3 to 40 g specimens irradiated by 7×10^{11} to 5×10^{12} protons/cm^2 sec showed that the heating is distributed evenly over the whole volume, including the surface. The temperature quickly reaches a saturation point and remains constant during the duration of the exposure. Graphs are included. (tr-auth)

36359 IRRADIATION EFFECTS IN SOME SWEDISH PRESSURE VESSEL STEELS. M. Grounes and H. P. Myers. Jernkontorets Ann., 146: 887-902(1962). (In Swedish)

The effects of neutron irradiation on tensile and impact properties of carbon-manganese steels, low-alloy steels, and unalloyed basic weld metals were investigated. (Rev. Metal Lit., 20: No. 8, Aug. 1963)

36360 EFFECTS OF RADIATION ON TRANSISTORS IN THE FIRST TELSTAR SATELLITE. D. S. Peck and E. R. Schmid (Bell Telephone Labs., Inc., Allentown, Penna.). Nature, 199: 741-4(Aug. 24, 1963).

The response of the Telstar communications satellite to its environment and to command experiments indicated the characteristic ionizing radiation effects on transistors, the variation of degradation with collector voltage, the recovery with removal of voltage, the sensitivity to dose rate, and the eventual effect of total dose. Comparison of laboratory results with those under actual orbiting conditions is a significant factor in indicating the appropriate testing techniques and exposure levels to be used in further studies. It was concluded that the emphasis in development of radiation-resistant circuits must be in the direction of reducing or eliminating the radiation sensitivity of transistor types. Tests indicated the insensitivity of most evacuated types of silicon transistors and that many planar types, even gas-filled, suffer only limited degradation in the region 10^6 to 10^7 rads. Applications of the findings in the production of transistors suitable for long life in satellites are discussed. (C.H.)

36361 ANNEALING OF γ-RAY IRRADIATED N-TYPE GERMANIUM. Shiori Ishino, Fumiko Nakazawa, and Ryukiti R. Hasiguti (Tokyo Univ.). Phys. Chem. Solids, 24: 1033-41(Aug. 1963). (In English)

Isochronal and isothermal annealing above room temperature was studied in antimony and arsenic doped γ-irradiated germanium. Three annealing stages are found at 370, 430, and 530°K with activation energies of 0.7 to 0.8 ev, 1.2 to 1.3 ev and 2.2 (As-doped) to 2.5 (Sb-doped) ev, respectively. Impurity dependence of annealing behavior is found in all these stages. The results are discussed in terms of electronic and elastic interactions of defect centers with impurity atoms. (auth)

36362 THE INFLUENCE OF GAMMA RADIATION ON THE PROPERTIES OF SOME FILM FORMING POLYMERS. Zbigniew Jedlinski, Zdzislaw Hippe, and Janina Zurakowska-Orszagh. Przemysl Chem., 42: 365-8(July 1963). (In Polish)

The influence of gamma radiation on the properties of coatings from polyethylene, polystyrene, polyvinyl alcohol, acetate, and chloride, chlorinated polyvinyl chloride, polyvinylbutyral, methyl polymethacrylate, chlorinated rubber, cyclized rubber, polyurethan, silicone, and epoxy resins, as well as copolymers of styrene with acrylic acid, vinyl chloride and vinylidene, vinyl chloride and isobutyl ether of vinyl alcohol, vinyl chloride and acetate, vinyl chloride, acetate and maleic ester, and vinyl chloride with acetate and maleic acid. It was observed that the changes of the properties of coatings after irradiation depend on their chemical structure. The correctness of the Miller principle was not confirmed in relation to film forming polymers. (auth)

36363 EFFECT OF X AND γ RADIATION ON THE STRUCTURE OF PHOSPHORS OF THE (Zn,Cd)S TYPE. Giovanni Schippa and Maria Serra (Università, Rome). Notiz. Ric. Sci., Rend., 3: 471-5(June 1963). (In Italian)

The effect of x and γ radiations on Cu-activated phosphors of the (Zn,Cd)S type with a hexagonal structure was examined. Irradiation with x rays induces in a short time a change in the atomic density on several planes of the lattice. With increasing exposure, the hexagonal-cubic transformation begins. Weak γ-ray intensity after 35 days induces the same order of lattice variations as those observed after a few hours of x-ray exposure. (tr-auth)

36364 CHANGES IN COLOR AND ELECTRIC CHARACTERISTICS OF GAMMA-RAY IRRADIATED SHIELDING WINDOW GLASS. Kakuji Yamamoto and Masao Tsuchiya. Tokyo Metropolitan Isotope Centre Ann. Rept., 1: 53-60 (1962). (In Japanese)

The coloration of shielding window glass of various kinds by γ irradiation was studied. With Co^{60} as the radiation source, 23 ± 3°C as irradiation temperature, 10^5 r/h as irradiation dose rate, and 10^5–10^7 r as total dose, the coloration increased gradually. The volume resistivity of glass and its change by gamma irradiation were measured. 100 v were applied to a sheet of glass sandwiched between two electrodes to measure the time change of its electric resistance. The quantity of induced space charge by radiation was calculated by time integration of the current that was obtained from the reciprocal of the resistance. Resistance of high density glass was found to become minimum–hence, the current becomes maximum–at 10^6 r and increased as the dose increased, but the resistance of medium density glass decreased gradually. The resistance change is exponential and always positive at any dose. This testifies that glass is electretized by radiation. On the other hand, linearity was established between the quantity of space charge and the dose in a range of 10^5–4×10^6 r. This suggests the possibility of the high density glass to be utilized for dosimetry. (P.C.H.)

36365 EFFECTS OF γ-RADIATION ON CATION EXCHANGE RESINS. Gisuke Meshitsuka, Tadayoshi Kubotera, and Masamichi Ikeda. Tokyo Metropolitan Isotope Centre Ann. Rept., 1: 67-70(1962). (In Japanese)

The effects of Co^{60} γ radiation on the exchange capacity, swelling characteristics, and oxidizability of the cation exchange resins were studied. Air-dry and wet cation exchange resins were irradiated (up to 6×10^7 r) in H, Na, Fe, and Pb form. Radiaiion caused a decrease in exchange capacity of the resins, and the rate of decrease was highest in H form, 6% at 5×10^7 r, then Na, Fe, and lowest in Pb form. The effect of irradiation on swelling characteristics of the resins was not remarkable throughout the whole range of radiation doses applied, except for H form resin. In this case, the swelling decreased remarkably at a dose over 6×10^7 r in a dry state, while it decreased only a little in a wet state. Pb form resin seemed most stable against radiation, both in a dry and a wet state. In a Fe form resin, the amount of functional groups lost by irradiation of 6×10^7 r corresponded to the total amount of ferrous and ferric ions liberated from the resin into water. (auth)

36366 ON THE HARDENING OF METAL SURFACE LAYERS BY IRRADIATION. P. E. D'yachenko, P. K. Oshchepkov, N. N. Tolkacheva, G. A. Andreev, V. A. Chudov, A. N. Goryunov, and L. N. Dubova. Tr., Akad. Nauk SSSR, Komis. po Tekhnol. Mashinostr., Seminar po Kachestvu Poverkhn., No. 5, 27-31(1961).

The thermal effect of nuclear irradiation on surface layers of metals was investigated after electronic, ionic, and dueteron irradiation. The equipment consisted of a voltage-pulse generator, electron gun, and a vacuum unit. Considerable increase in the wear resistance of metals resulted from the levelling of micro-irregularities, fusion of micro-cracks, and sudden quenching of the surface layer. In a second test, ionic irradiation was achieved in a unit for the electromagnetic separation of isotopes by irradiation with titanium ions. The titanium diffused into the surface of the specimens to a depth of 110 microns and wear resistance increased by as much as 20 times compared to the initial resistance. Microhardness increased by as much as 1.5 times. Deuteron irradiation was performed in a cyclotron and resulted in an increase of microhardness by a factor of 2-3, and of wear resistance by a factor of 2-2.5. (OTS)

36367 IRRADIATION DAMAGE IN SOME NON-FISSILE CERAMICS. F. J. P. Clarke, D. H. Bowen, and R. S. Wilks (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Trans. Brit. Ceram. Soc., 62: 83-95(Feb. 1963).

The effects of reactor irradiation of ceramic materials are discussed with particular reference to mechanisms resulting in the formation of clusters of point defects. The annealing behavior of defect loops formed by irradiation of magnesium and beryllium oxides is described and discussed in relation to macroscopic property changes that have been observed in beryllium oxide. (auth)

36368 FACILITY AND EQUIPMENT FOR THE HRLEL (Engineering Materials). (Oak Ridge National Lab., Tenn.). (CAPE-1014)

This package contains 36 photos and 505 drawings. The High Radiation Level Examination Laboratory (HRLEL) was designed for use in studying the influence of nuclear radiation on different substances under various environmental conditions in order to develop improved structural, moderator, control, fuel and shielding materials. The HRLEL is located in a two-story brick building with a partial basement. Thirteen main cells are located on the first floor in three straight-line banks arranged in the form of a "U." The operating cells are 6 ft wide, 10 ft deep and 14 ft high. The two corner cells are somewhat wider. The 13 cells contain 15 oil-filled lead-glass windows with a pair of master slave manipulators at each window. Most of the laboratory equipment is portable for greater flexibility and better operating efficiency. Periscopes, cameras, stereomicroscopes, telescopes, and television cameras are employed in inspecting exposed or accessible surfaces of opaque materials and interiors of transparent objects. Ultrasonic and eddy current techniques are used in the nondestructive testing methods to study nonbonding and cracks. Commercial apparatus was modified to produce remote control equipment for use in the caves. A gamma scanning device is used to study fuel burnup and induced-activity measurements. This device consists of a mechanical positioner, collimator, and a scintillation counter. The gamma spectrometer is a fully transistorized, 250-channel analyzer with a readout typewriter, oscilloscope, and an x-y point recorder. Gas-pressure buildup causing rupture in metal clad fuel elements is studied which necessitated equipment to pierce capsules of steel, nickel, and beryllium; and sampling equipment to attain aliquots of fission gases. Milling machines, abrasive cutoffs, and pipe cutters are used in destructive testing. Balances, defilming and replication equipment are used to study chemical corrosion, mechanical erosion, and crud deposition. Metallographic examination is employed to study internal structures. Two types of metallographs, Ruchert Telatoms and Bausch & Lomb were modified for remote operation. Auxiliary equipment used in metallographic examination includes ultrasonic cleaners, electroplating equipment, presses, grinders, polishers, hardness testers, and etchers. The metallurgical equipment also includes transfer mechanisms. X-ray diffraction analysis is used to examine solid or powdered polycrystalline materials. Shielded containers are used to transport waste and for storage. See also CAPE-556, Syntron Polisher, and CAPE-921, Metallurgical Equipment Used at the HRLEL, for materials describing other equipment. (R.E.C.D.)

36369 EURATOM CAPSULE EXPERIMENTS ON UO_2 CENTRAL MELTING. M. F. Lyons, R. F. Boyle, T. J. Pashos, R. L. Straley, and B. Weidenbaum (General Electric Co., San Jose, Calif.). 32p. (CONF-11-9)

From American Nuclear Society 1962 Winter Meeting, Washington, D. C., Nov. 1962.

Three sintered-pellet UO_2-filled, Zircaloy-clad capsules were irradiated. All three capsules operated at sufficiently high surface heat flux to produce central melting. Preliminary results were presented on the appearance of the UO_2 following short-time irradiation at high heat flux, the capsule surface heat flux necessary to induce central melting, and the apparent UO_2 conductivity and pellet-clad interface conductivity during irradiation. In addition, the required surface heat flux to induce central melting in low enrichment fuel rods of identical geometry was estimated. (auth)

PHYSICS

General and Miscellaneous

Refer also to abstract 35765.

36370 (AD-295052) THE DEVELOPMENT OF AN AUXILIARY ELECTRODE THERMIONIC CONVERTER. Fourth Quarterly Technical Report. W. B. Hall and J. J. O'Grady (Radio Corp. of America. Electron Tube Div., Lancaster, Penna.). Dec. 28, 1962. Contract AF33(657)-8005. 54p.

Progress is reported on research conducted to improve the efficiency and life expectancy of thermionic energy converters for space applications. The program was modified to the development of a cylindrical converter, the emitter of which is thermally bonded to but electrically insulated from a central heat-source tubing carrying liquid metal. Significant progress was achieved in the various portions of the program. A particular geometry employing the "Cross-Current Converter" principle was selected and the overall design determined. Two promising methods for the application of the emitter insulation are being evaluated. The effects of cesium on ceramics at the various temperatures of interest were observed and the results analyzed. (auth)

36371 (AD-291507) AN EXPERIMENTAL INVESTIGATION OF THE EFFECTS OF RADIATION ON THE PROPAGATION OF ELECTROMAGNETIC SIGNALS IN AIR. Fifth Quarterly Progress Report. M. N. Hirsh and P. N. Eisner (Dewey (G. C.) and Co., Inc., New York). Sept. 30, 1962. Contract DA-36-039-SC-87318. 30p. (R-146-5)

Modifications were made to the apparatus to increase the range and accuracy of measurements. The equilibrium ionization produced in air and oxygen by the electron beam was measured at various pressures. Frequency shifts vs beam current are displayed for the two media. The ionization in air was considerably greater than that in oxygen at the same pressure for a given beam current. The oxygen data at pressures above 3 mm Hg can be interpreted quite well in terms of 3-body attachment. Possible explanations for the lower pressure data are considered. The air experiments did not give reproducible results. (D.C.W.)

36372 (AD-410495) INVESTIGATION OF THE MONO-CAPILLARY THERMIONIC EMITTER AS A DUAL SOURCE OF IONS AND ELECTRONS. Fifth Quarterly Technical Progress Report for the Period February 15–May 15, 1963. D. L. Dresser, J. D. Dunlop, and R. T. Schneider (General Motors Corp. Allison Div., Indianapolis). June 15, 1963. Contract AF33(616)-8299. 94p. (EDR-3390)

Experimental data are reported on a multicapillary converter, Converter G, which operated for over 300 hours. Several types of data were obtained including: current-voltage characteristics for the temperature range from 1800 to 2100°K, high-frequency oscillations, ion current measurements, and spectroscopic data. It is shown that the data in the temperature range from 1800 to 2100°K agree with the random current model of the capillary emitter. For operation at 2000 and 2100°K the data indicate several competitive advantages over conventional converters, including wider electrode spacings, higher converter voltage, and lower cesium bath temperature. The high frequency oscillation data show that the peak current-voltage points form an arc mode characteristic. The ion currents at high collector temperature appear to be due to cesium atoms evaporating from the collector and impinging on the emitter surface. Spectrographic data indicate elevated electron temperatures in the arc mode. When high frequency oscillations are present in the passive mode, the line intensities of lower energy excited states are increased. (auth)

36373 (ASD-TDR-62-693) POWER CONVERSION BY ELECTRON CONVECTION. S. R. Hoh and W. L. Harries (ITT Federal Labs. Div. of International Telephone and Telegraph Corp., Nutley, N. J.). Aug. 20, 1962. Contract AF33(616)-7941. 32p. (AD-291683)

A new electrohydrodynamic system that is capable of converting thermal into electrical power was studied. Conversion was accomplished by the forced convection of thermionic electrons emitted from an alkaline metal emitter. Analytical and experimental studies showed that this new type of converter is feasible and practical. Outputs up to 18 volts were obtained under open circuit condition with emitter temperatures as low as 450°C. Short circuit output currents were near the emission current of the emitter. (auth)

36374 (BNL-6491) WAVE FUNCTIONS FOR ANTI-SHIELDING FACTORS OF IONS AND FOR THE ELECTRONIC POLARIZABILITIES OF THE ALKALI ATOMS. R. M. Sternheimer (Brookhaven National Lab., Upton, N. Y.). Oct. 19, 1962. Contract [AT(30-2)-Gen-16]. 34p.

Supplement to Phys. Rev., 127: 812-16(Aug. 1, 1962).

Tables are presented for the following perturbed wave functions: (1) v_1^i (nl → l′) for the perturbation of the d electrons of Cu^+, V^{2+}, Ag^+, and Hg^{2+} by the nuclear quadrupole moment; (2) $v_{1,H}{}'$(nl → l) for the antishielding of the d electrons for a possible hexadecapole moment in Cu^+, Ag^+, and Hg^{2+}; and (3) u_1^i (ns → p) for the dipole perturbation of the valence atoms of the alkali atoms. (D.L.C.)

36375 (CONF-176-2) CURRENT-CARRYING CAPACITY AND TRANSITION STATE OF SUPERCONDUCTING SOLENOIDS. W. F. Gauster and D. L. Coffey (Oak Ridge National Lab., Tenn.). [1963]. Contract [W-7405-eng-26]. 15p.

From Cryogenic Engineering Conference, Boulder, Colo., Aug. 1963.

A solenoid wound with high-field superconducting wire displays maximum currents and fields (H) that are less than the critical field of the wire itself in an equal field (H). Montgomery's and Chandrasekhar and Hulm's models for these maximum properties indicate, respectively, a unique coil quenching characteristic for geometrically similar solenoids and one unique characteristic for all solenoids with identical wire type and turn distance. Experiments with Pb coils did not verify Montgomery's model and contradicted Chandrasekhar and Hulm's model. The experimental results, however, did support an analysis of the surface currents in an ideal superconducting infinitely long solenoid. (D.C.W.)

36376 (CONF-186-1) SCATTERING OF A VELOCITY SELECTED POTASSIUM BEAM BY NEON, ARGON, AND XENON GASES AT DIFFERENT TEMPERATURES. Howard H. Brown, Jr., Kotu Lulla, and Benjamin Bederson

(New York Univ., New York). [1962]. Contract [AT (30-1)-1480]. 22p.

From 3rd International Conference on the Physics of Electronic and Atomic Collisions, London, July 1963.

A thermal K beam was velocity selected, and scattered by Ne, Ar, and Xe gases. The dependence of the total cross section on relative velocity is approximately $v^{-0.4}$ for K–Ar and K–Xe, and $v^{-0.8}$ for K–Ne. The average relative velocity ranges were 400 to 1430 m/sec for Ne, 480 to 1350 m/sec for Ar, and 380 to 1320 m/sec for Xe. The dependence of the cross section on relative velocity was obtained by removing the cross section from the collision frequency integral. For the $v^{-0.4}$ dependences, this gives results correct to 3%. For the $v^{-0.8}$ dependences, the error is most likely greater. Three gas temperatures were used: liquid air, room, and 200°C. The results for a given gas at different temperatures are consistent with kinetic theory predictions. (auth)

36377 (GA-3798) HIGH-TEMPERATURE VAPOR-FILLED THERMIONIC CONVERTER. Quarterly Technical Progress Report for the Period October 1–December 31, 1962. W. Godsin (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Jan. 7, 1963. Contract AF33 (657)-8563. 21p. (AD-295907)

Cell F was operated at power for 484 hours. Cell F is the first cell in which the expected current emission density was observed from a carbide emitter in an engineered thermionic generator. Short-circuit currents of 120 amp were observed from the emitter in the cell. A maximum power output of 50 watts (5 w/sq cm) was obtained at an emitter temperature of 2440°K. During steady state operation power was in the range from 10 to 30 watts. The cell was not optimized for maximum power. The contact potential in the cell agrees with that expected from a low work function carbide emitter and a fully cesiated collector. For a nominal contact potential of 1 volt and a short-circuit current of 120 amp, the optimum power should have been 120 watts, assuming no transport defects in the cell. Actually the maximum power output corresponding to a short-circuit current of 120 amp was more nearly 40 watts, indicating transport defects in the cell. (auth)

36378 (IITRI-1184-10) MAGNETIC PROPERTIES OF INSULATORS. Quarterly Report No. 10, May 16, 1963 to August 15, 1963. Jordan J. Markham (Illinois Inst. of Tech., Chicago. IIT Research Inst.). Sept. 5, 1963. Contract AT(11-1)-587. 42p.

Detailed measurements on the optical absorption of the F-center in rubidium chloride are reported. The F-centers were produced by additive coloration and ionizing radiation. The photon energies for the point of maximum and points of half maximum absorption are determined for temperatures between 4 and 373°K. A single effective phonon frequency of $\omega = (2\pi) \times 3.54 \times 10^{12}$ sec^{-1} is obtained from the dependence of the half width on temperature. The shape of the F-band is independent of temperature and is not symmetrical. The moments are computed. The asymmetry is greater than that predicted by the Poisson distribution and the second moment is close to that of a Gaussian. The ratio of the maximum in the K-band to that of the F-band is 0.03 in vacuum distilled material. In unpurified material this value is not reproducible and may be three times as large. (auth)

36379 (ISS-63/29) IL SEMINARIO DEI LABORATORI DI FISICA NEL QUADRIMESTRE GENNAIO–APRILE, 1963. PARTE I. (The Seminar at the Physics Laboratory During January–April 1963. Part I). (Italy. Istituto Superiore di Sanità, Rome). May 10, 1963. 58p.

A synopsis of the lectures held at the Physics Laboratory of the ISS during January–April 1963 is presented. Abstracts were prepared for two of the lectures. (J.S.R.)

36380 (ISS-63/29(p.1-13)) PRODUZIONE DI STATI RISONANTI NELL'URTO K^--p. (Production of Resonant States in K^--p Interactions). G. C. Moneti (Rome. Università. Istituto di Fisica).

The partial results of a study on the interaction of K^- mesons at 2.24 Bev/c in a hydrogen bubble chamber are reported. The purpose was the determination of the properties of the Ξ particle and of the previously known hyperon-pion and K meson-pion resonant states, as well as of the new resonant states $\Xi\pi$, ΞK, ΛK, $K\bar{K}$. The experimental conditions are defined, and the properties of the K^- beam are given. The measurement and analysis are described. The results of the analysis of the reactions $K^- + p \rightarrow \Xi + \pi + K$ and $K^- + p \rightarrow \Lambda + K + \bar{K}$ are reported. (J.S.R.)

36381 (ISS-63/29(p.13-21)) IL MODELLO PERIFERICO NELLE COLLISIONI NUCLEONE-NUCLEONE. (Peripheral Model of Nucleon-Nucleon Collision). E. Ferrari (Rome. Universita. Istituto di Fisica).

An interaction mechanism that describes qualitatively the tendency of the initial particle (in nucleon-nucleon interactions above 1 Bev) at the center of mass to conserve in form and direction the pulse first from the collision and to lose little energy is the "peripheral model." The interaction between two initial nucleons is represented by the exchange of a single virtual pion between them. An example of a peripheral graph is given and analyzed. Experimental results on the spectra of neutrons and protons from $p + p \rightarrow p + n + \pi^+$ and $p + p \rightarrow p + p + \pi^0$ are compared with the predictions of the peripheral model as determined by Prato and Ferrari and Selleri. The variation of the cross section for these reactions as a function of the incident energy agrees with the peripheral model at energies above 800 Mev. (J.S.R.)

36382 (ISS-63/30) IL SEMINARIO DEI LABORATORI DI FISICA NEL QUADRIMESTRE GENNAIO–APRILE 1963. PARTE II. (The Seminar at the Physics Laboratory During January–April 1963. Part II). (Italy. Istituto Superiore di Sanità, Rome). May 10, 1963. 145p.

A synopsis of the lectures held at the Physics Laboratory of the ISS during January–April 1963 is presented. Abstracts were prepared for two of the lectures. (J.S.R.)

36383 (ISS-63/30(p.55-67)) POSSIBILITÀ DI UNO STUDIO SPERIMENTALE DELL'INTERAZIONE $\pi\pi$. (Possibility of an Experimental Study of $\pi\pi$ Interaction). F. Selleri (France. Commissariat à l'Energie Atomique. Centre d'Etudes Nucleaires, Saclay).

A method for the indirect measurement of $\pi\pi$ interactions was suggested by Chew and Low. It was based on the assumption that one of the possible mechanisms for the production of pions in pion-nucleon collisions is the elastic scattering of the incident π by a π in the nucleon cloud. An analysis of the method suggests an extrapolative method for the measurement of $\pi\pi$ interactions. The difficulties of this method are indicated by a discussion of the calculations in the case of elastic e-p scattering. However, it is shown that the extrapolation method offers the possibility of a detailed study of $\pi\pi$ interactions. (J.S.R.)

36384 (ISS-63/30(p.90-100)) L'IPOTESI DI ALFVÈN-KLEIN SULLA PRESENZA DI ANTIMATERIA NELL'UNIVERSO. (Alfven-Klein Hypothesis on the Presence of Antimatter in the Universe). A. Reale (Italy. Istituto Superiore di Sanita, Rome).

The cosmological theory recently formulated by Alfven

and Klein shows the possibility of the existence of a combined gravitation and magnetic mechanism as a consequence of which matter and antimatter would be separate. The presence or not of antimatter cannot be decided on the basis of the theory, but the existence of radiogalaxies can perhaps shed some light on this subject. The Hoyle and Fowler hypothesis on the implosion of gaseous matter furnishing the necessary energy for radiogalaxies would negate the need for the serious consideration of the annihilation of antimatter as the energy source of these galaxies. (J.S.R.)

36385 (JINR-E-1314) ON THE LEADING SINGULARITY IN THE ANGULAR MOMENTUM PLANE IN PERTURBATION THEORY. P. Suranyi (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1963. 8p.

The integral equation of ladder approximation is solved in theories with a dimensionless coupling constant, and a fixed cut is found as a leading singularity in the l-plane. The method is generalized for arbitrary diagrams giving again a similar type of leading singularity. (auth)

36386 (LADC-5797) ENHANCED RADIATION FROM IONIZED GASES. H. Dreicer (Los Alamos Scientific Lab., N. Mex.). [1962]. Contract [W-7405-eng-36]. 30p. (CONF-75-5)

From 6th International Symposium on Ionization Phenomena in Gases, Orsay, France, July 1963.

Two problems that require a more detailed description of the interaction between particles and a radiation field than is provided by the Boltzmann equation are considered. An electron-photon collision term is introduced and applied to saturation in the cyclotron radiation maser, illustrating the electron momentum distribution relaxation by cyclotron emission and absorption. Also, the photon transport equations that govern photon scattering by electrons and plasmons when the radiation field is non-thermal and intense enough to enhance the scattering are derived and evaluated. (auth)

36387 (MATT-90) IDENTIFYING SPECTRAL LINES ON A COMPUTER. Harold Vandenburgh and Lanny Hoffman (Princeton Univ., N. J. Plasma Physics Lab.). Aug. 1962. Contract AT(30-1)-1238. 93p.

A computer program for analyzing spectrograms on an IBM 650 is described. Observed lines are correlated with tabulated multiplets in first, second, and third orders on the basis of wavelengths, and the correlations and uncorrelated lines are listed. Flow charts, program and multiplet table listings, and sample output are included. (D.C.W.)

36388 (NP-13020) PROCEEDINGS OF THE NUCLEAR PHYSICS SYMPOSIUM, 1963, BOMBAY, FEBRUARY 27–MARCH 2, 1963. (India. Dept. of Atomic Energy. Physics Advisory Committee, Bombay). 485p.

Available from Scientific Information Officer, Atomic Energy Establishment Trombay, Bombay, India.

Topics covered in the 67 papers include nuclear spectroscopy, nuclear reactions, nuclear instrumentation, neutron scattering and diffraction, and nuclear and electron magnetism. Of these, there are 51 papers abstracted and 5 previously abstracted for NSA. (R.E.U.)

36389 (NP-13020(p.1-26)) STUDIES ON NUCLEAR ORIENTATION. A. Kastler (Tata Inst. of Fundamental Research, Bombay).

The effects and phenomena of the interaction energy of a magnetic moment with an external field, which may not show up in nuclear physics, can be studied by r-f spectroscopy techniques. For example, the resonance line shifts under suitable conditions may be only one or two cps. This may be of fundamental interest for those working in r-f spectroscopy, especially for the interaction of radiation with matter. The methods of optical pumping to obtain nuclear orientation are described. (R.E.U.)

36390 (NP-13020(p.27-33)) RECENT RESULTS ON INTERNAL CONVERSION. M. K. Ramaswamy (Karnatak Univ., Dharwar, India).

The theory of internal conversion was shown to be more realistically explained using a model in which the charge on the nucleus is distributed uniformly on a sphere of radius R rather than using the simplifying assumption that the nucleus can be treated as a point charge. The importance of penetration of an atomic electron into the nuclear volume and the new matrix elements introduced is considered. It is concluded that there is general agreement between theory and experiment when finite size effects are taken into account. (R.E.U.)

36391 (NP-13020(p.34-8)) RADIATION FROM THE DECAY OF ^{117}Cd. R. P. Sharma, K. P. Gopinathan, and S. R. Amtey (Tata Inst. of Fundamental Research, Bombay).

The decay of Cd^{117} is studied with a view to investigate the previously reported 50-minute isomer, which was obtained by milking from 1.1-minute Ag^{117} from fission products, and also to study the energy levels of In^{117}. A flux of 10^{12} neutrons/cm^2/second was used to produce Cd^{117} from 96 per cent enriched Cd^{116}. A methane-flow proportional counter was used to investigate the gross beta activity of the 50-minute isomer. (R.E.U.)

36392 (NP-13020(p.39-42)) LEVELS IN ^{115}In. R. P. Sharma and H. G. Devare (Tata Inst. of Fundamental Research, Bombay).

The levels in In^{115} were studied in the decay of the 43-day activity of Cd^{115m}, with a view to see whether the levels indicated by the inelastic scattering experiments are fed in this decay and also their de-excitation modes. Earlier work has indicated the energy levels at 930, 1300, and 1420 kev which are fed in the decay of Cd^{115m}. A 98%-enriched Cd^{114} sample was irradiated in a flux of 10^{14} neutrons/cm^2/sec and was kept for 40 days to allow for the decay of 53-hour Cd^{115} activity. Thus, only Cd^{115m} activity was obtained, and its gamma spectrum was studied. (R.E.U.)

36393 (NP-13020(p.48-52)) E3 TRANSITION IN ^{121}Sb. R. Bhattacharyya and S. Shastry (Saha Inst. of Nuclear Physics, Calcutta).

Investigations on the highest excited state of Sb^{121} and its decay mode are presented. The highest excited state was determined by using a NaI(Tl) phosphor in conjunction with a photomultiplier and 20-channel pulse height analyzer. It was found to be at 1130 kev. It was concluded that this state decays by a direct transition to the ground state and through a parallel 1060–70 kev cascade, the branching intensities being comparable. (R.E.U.)

36394 (NP-13020(p.53-7)) BETA AND GAMMA RAY SPECTRUM OBSERVED IN THE DECAY OF ^{134}Cs. P. N. Trehan (Punjab Univ., Chandigarh, India).

The decay of 2.19-year Cs^{134} leads to the excited levels of Ba^{134} by beta emission. This was extensively studied by various workers, but disparity is found in their results. An effort to clarify the situation is presented. Gamma rays from the decay of Cs^{134} were measured using a NaI(Tl) crystal mounted on a photomultiplier tube and a 20-channel analyzer. A double-focusing magnetic spectrometer was used to analyze the beta spectrum of Cs^{134} using a plastic phosphor as a detecting device. (R.E.U.)

36395 (NP-13020(p.58-61)) DECAY OF THE NEW 2.5 MIN. ^{201}Pt. K. P. Gopinathan, M. C. Joshi, and

M. Radha Menon (Tata Inst. of Fundamental Research, Bombay).

A new activity of half life 2.3 ± 0.2 min was identified from (n,α) reaction products of mercury irradiated in a reactor and was assigned as due to Pt^{201} by establishing its genetic relation to 27-min Au^{201}. A more accurate value of the half life of Pt^{201} is obtained, and its decay scheme is established. An oxide of mercury was irradiated in a flux of 10^{12} neutrons/cm^2/sec and then dissolved in hydrochloric acid in the presence of 6 mg of platinum and gold carriers. The platinum was separated, and the sample was covered with scotch tape. The gamma spectrum was studied using a NaI(Tl) crystal and a 512-channel pulse-height analyzer. The half life obtained is 2.5 ± 0.1 min. The beta spectrum was taken with an anthracene crystal and a 512-channel pulse-height analyzer. (R.E.U.)

36396 (NP-13020(p.62-8)) BETA-DECAY EXPERIMENTS AND NUCLEAR STRUCTURE. S. K. Bhattacharjee (Tata Inst. of Fundamental Research, Bombay).

Using known beta interactions, useful information about the nuclear matrix elements is obtained and thus predirections of nuclear models can be checked. The vector-type matrix elements of the beta transitions are considered for different nuclides. (R.E.U.)

36397 (NP-13020(p.69-74)) ON THE ANGULAR CORRELATION OF GAMMA-RAYS FOLLOWING ALLOWED β-TRANSITIONS. B. N. Subba Rao (Tata Inst. of Fundamental Research, Bombay).

There is considerable support from experimental findings to the belief in the possibility that all weak interactions can be of the V-A type, with suitable corrections for the presence of other modifying effects wherever they are present. The results of measurements of angular correlations of the cascades are given. (R.E.U.)

36398 (NP-13020(p.80-4)) E2–M1 MIXING RATIO IN 2+ → 2+ TRANSITION. N. C. Singhal and P. N. Trehan (Punjab Univ., Chandigarh, India).

A general feature of the decay of the second 2+ level in even-even nuclei in the medium weight region is that it decays by a weak crossover transition of E2 character to the ground state and by a slightly stronger cascade transition to the first excited 2+ level. This last transition is the only transition for which enough experimental data on E2–M1 mixing are available. Various measurements of δ values are presened and are compared with the theoretical predictions by Davydov and Filippov. (R.E.U.)

36399 (NP-13020(p.85-91)) CORE EXCITATIONS IN NON-DEFORMED ODD-A NUCLEI. M. C. Joshi (Tata Inst. of Fundamental Research, Bombay).

The several known ways of exciting the nucleus from its ground state to higher levels are discussed. Some of the appropriate models used are: the independent-particle model, the quasi-particle model, and a model in which an odd-A nucleus is treated as a coupled system comprising an even-even core with surface vibrational frequencies corresponding to the adjacent even-even nucleus, plus an extra particle moving in its effective spherical potential. (R.E.U.)

36400 (NP-13020(p.96-100)) COLLECTIVE MODEL FOR ^{28}Si. Raj K. Gupta (Punjab Univ., Chandigarh, India).

Different models are suggested to describe the Si^{28} nucleus. An analysis is given showing that Si^{28} is a fairly deformed nucleus and has rotational structure instead of the pure vibrational structure. A correction is needed for a better approximation to the axially symmetric rotor model. As far as the level scheme is concerned, Davydov–Filippov model can be very well extended to the light-weight nuclei of 1d-2s shell. Further experimental verification is suggested. (R.E.U.)

36401 (NP-13020(p.101-6)) SMALL ANGLE COHERENT SCATTERING OF Cs^{137} γ-RAYS. A. Nath and A. M. Ghose (Bose Research Inst., Calcutta).

Experimental studies on the small-angle coherent scattering of Cs^{137} γ rays were made, with a multisection annular filter arrangement, to study the angular distribution of the Rayleigh scattering cross section in Pb, Sn, and Cu and the Z-dependence of the Rayleigh scattering at different scattering angles. (R.E.U.)

36402 (NP-13020(p.108-20)) SOME ASPECTS OF NUCLEAR STRUCTURE. M. K. Pal (Saha Inst. of Nuclear Physics, Calcutta).

Nuclear spectra of the single-nucleon level schemes in nuclei with closed shell are used as a starting point for calculating the spectra of more complex nuclei in the neighborhood of a closed-shell nucleus. Here the effect of the residual two-nucleon interaction must also be included. The excitation of the closed-shell nuclei is considered before work on configuration mixing carried out for the case of many nucleons outside a closed shell is taken up. In nuclei having a few nucleons outside the closed shell the giant dipole and octupole states are thought to be essentially characteristic of the vibration of the nearby closed shell. The extra nucleons introduce minor modifications through angular momentum coupling and do not essentially change the collective characteristics. The method of commutators is applied to the full Hamiltonian incorporating all two-nucleon interactions. This is an effort to apply the pairing theory to the neutron–proton case where this interaction can be treated as a perturbation due to the fact that neutrons and protons in the nuclei chosen are filling up different levels. (R.E.U.)

36403 (NP-13020(p.121-4)) ANGULAR MOMENTUM DEPENDENCE OF THE EFFECTIVE TWO-BODY NUCLEAR INTERACTION. Y. R. Waghmare (Punjab Univ., Chandigarh, India).

Knowing that nuclear forces act only between the pairs of particles has not been sufficient to give a satisfactory explanation about the situation in the structure of nucleons inside a nucleus. However, information is available regarding binding energy, nature of the nuclear potential, and the so-called "reaction matrix," on the basis of Brueckner theory. The reaction matrix in Brueckner theory is the analog of effective two-body interaction in a phenomenological two-body problem. A detailed study of this effective two-body nuclear interaction is given. (R.E.U.)

36404 (NP-13020(p.125-8)) AN EMPIRICAL RELATION FOR ALPHA DISINTEGRATION ENERGIES FOR MEDIUM-HEAVY ELEMENTS. M. Rama Rao (Saha Inst. of Nuclear Physics, Calcutta).

Ionization chambers, emulsion plates, and cloud chambers are a few devices used in the measurement of alpha disintegration energies of rare-earth and other medium-heavy elements. More available data have made possible the study of α systematics in an effort to present empirical relations for disintegration energies of different nuclides. The relation $Q = 0.624\ Z - 2.1\ A - 5.5$ is given for $N > 82$ and $Z < 82$. (R.E.U.)

36405 (NP-13020(p.129-44)) ON PHOTONUCLEAR REACTIONS. Evani Kondaiah (Tata Inst. of Fundamental Research, Bombay).

Photonuclear reactions are special in that photons have very little momentum compared to other particles of the

same energy, and it is difficult to obtain sources of smoothly variable monoenergetic photons for experimental studies. Details discussed include photon sources, main features of photonuclear reactions, the collective model and the independent-particle model, and other models and their predictions. It is stressed that the independent-particle model gives a detailed and cogent picture of the photonuclear reactions whereas the collective model describes the absorption adequately. (R.E.U.)

36406 (NP-13020(p.145-9)) LOW ENERGY THERMONUCLEAR REACTIONS IN THE GIANT STARS. H. L. Duorah (Gauhati, India. Univ.).

The thermal energy available in stellar interiors is only a few kev which, along with the coulomb barriers, causes nuclear reactions to be "low energy." Because of the contraction-burning-contraction process during the life of a star there may be a variety of reactions possible due to rising temperature and density. Types of reactions and rates of reaction are discussed. The pure helium star models of Cox and Guili are used in calculations of abundances of helium burning products. (R.E.U.)

36407 (NP-13020(p.155-9)) THE STUDY OF $^{59}Co(n,p)^{59}Fe$ REACTION AT 14.8 Mev. R. K. Mohindra (Punjab Univ., Chandigarh, India) and H. S. Hans (Aligarh Muslim Univ., Aligarh, India).

A proportional counter telescope was used with a target of Co^{59} that was 34.2 mg/cm^2 thick and 3 cm in diameter. The energy spectra of protons were studied at 4 different reaction angles. Experimental and calculated angular distribution plots are given for various energy ranges. The level density functions of Newton, Lang, and LeCouteur were used for statistical theory calculations. (R.E.U.)

36408 (NP-13020(p.160-5)) LOW-ENERGY GAMMA RAY SPECTRA FROM THERMAL NEUTRON CAPTURE IN Cd, Sm, AND Gd. D. L. Sastry and Swami Jnanananda (Andhra Univ., Waltair, India).

The three elements Cd, Sm, and Gd were chosen because of their high radiative capture cross sections. A two-curie Po–Be neutron source was used for the study, and the results were compared. Absolute intensities of the gamma lines were found using the 480-kev gamma line emitted in the reaction $B^{10}(n,\alpha)Li^{7}$ as a known line with which the others were compared. It is concluded from the magnitudes of the intensities that the formation of low-lying states in product nuclei is strong. (R.E.U.)

36409 (NP-13020(p.166-8)) TRENDS IN THE (n,α) CROSS-SECTIONS AT 14 Mev. A. Chatterjee (Saha Inst. of Nuclear Physics, Calcutta).

It was found that four regions exist between Z = 15 and 83 because of abrupt decreases in the (n,α) cross section with increasing Z. These decreases or dips correspond to the proton closed-shell configurations of the residual nuclei. The cross section is plotted against Z and also against A – Z. (R.E.U.)

36410 (NP-13020(p.169-73)) MEASUREMENT OF (n,p) REACTION CROSS-SECTION OF 14 Mev NEUTRONS IN LOW Z ELEMENTS. B. Mitra and A. M. Ghose (Bose Research Inst., Calcutta. Nuclear Physics Lab.).

Neutrons from Bose Institute 250-kv Cockcroft-Walton accelerator were used because of a minimum energy spread of the incident neutrons. Measurements were made relative to the reaction cross section of $Cu^{63}(n,2n)Cu^{62}$, which is 507 ± 45 mb. The samples were irradiated inside a cadmium box, to eliminate thermal neutron contribution, as this has a large cross section in many elements. Results are given for O^{16}, F^{19}, Na^{23}, Al^{27}, Si^{28}, and V^{51}. (R.E.U.)

36411 (NP-13020(p.174-85)) FIELD THEORETIC METHODS IN DIRECT INTERACTION THEORY. A. Goswami (Saha Inst. of Nuclear Physics, Calcutta).

Possibilities are discussed of applying recently devised methods to nuclear direct reaction theory. Discussion is confined to reactions of the type A(x,y)B, e.g., stripping and pick up. Quantum mechanical treatment is given. (R.E.U.)

36412 (NP-13020(p.186-200)) MULTIPLE SCATTERING IN THE PROBLEMS OF NUCLEAR PHYSICS. S. Mukherjee (Saha Inst. of Nuclear Physics, Calcutta).

A scattering matrix is given to describe the scattering of a nucleon from a nucleus. This requires the knowledge of the total wave function, which is given. The role of multiple scattering in the case of deuteron break-up by protons in the low-energy range is considered. The results of the all-order-multiple-scattering are shown by graphs, at various incident proton energies and angles. (R.E.U.)

36413 (NP-13020(p.201-13)) POLARIZATION PHENOMENA IN CHARGED PARTICLE REACTIONS. A. S. Divatia (India. Atomic Energy Establishment, Trombay).

The polarization of nucleons is with respect to a fixed direction in space, which may be defined by an external magnetic field, or the orbital angular momentum of the nucleon. From this there are two possible orientations of the nucleon spin and, correspondingly, there are two possible substates for the nucleons. Since polarization is a function of the populations in substates, it is defined in terms of the wave functions of these particles. The object of this study is (1) to study the properties of nuclei, such as spins and parities of nuclear levels, and (2) to study the nature of nuclear interaction. Various types of experiments using charged particles are considered. (R.E.U.)

36414 (NP-13020(p.214-26)) SCATTERING OF POLARIZED NEUTRONS BY NUCLEI. K. V. K. Iyengar (Tata Inst. of Fundamental Research, Bombay).

Measurements from scattering of polarized particles are useful to check phase-shift analysis based on angular distribution data. Polarization depends on the interference of partial waves and is therefore affected by the presence of partial waves which undergo even a small phase shift. This scattering furnishes information on the strength of spin-orbit interaction in nuclear collisions. Particles undergoing nuclear scattering will be polarized if spin-orbit forces are present. Information from scattering of polarized nucleons on nuclei is of importance in the development of the optical model. A method for the detection of polarized neutrons is given. (R.E.U.)

36415 (NP-13020(p.227-8)) EMISSION OF PROMPT RADIATION IN THE THERMAL NEUTRON FISSION OF U-235. S. S. Kapoor, R. Ramanna, and P. N. Rama Rao (India. Atomic Energy Establishment, Trombay).

Time-of-flight techniques were used to measure the energy distributions of the prompt neutrons emitted along the direction of motion of the light and heavy fragments in the laboratory system. From this, the emission spectra of the prompt neutrons were obtained for emission from the selected light and heavy fragments. Information on the temperature distribution of fission fragments is discussed. Angular correlation of the prompt gamma rays and fission fragments was also obtained. (R.E.U.)

36416 (NP-13020(p.251-4)) APPLICATION OF HOOGENBOOM TECHNIC IN THE MEASUREMENT OF ANGULAR CORRELATION. R. Bhattacharyya, S. Chatterjee, and S. Sastry (Saha Inst. of Nuclear Physics, Calcutta).

The technique of external pulse-summing, thereby ob-

taining improved resolutions in a scintillation gamma spectrum, was developed by Hoogenboom. An application of this technique for measurement of gamma-gamma angular correlation is described. A block diagram of the experimental arrangement is given. (R.E.U.)

36417 (NP-13020(p.255-9)) STUDY OF $^{19}F(n,\alpha)^{16}N$ REACTION USING A COUNTER TELESCOPE. U. T. Raheja and E. Kondaiah (Tata Inst. of Fundamental Research, Bombay).

A three-counter telescope consisting of two-gas proportional counters and a surface barrier detector was constructed. Orientation of the two-gas proportional counters and operation in coincidence reduce the cosmic-ray background to a minimum. Neutrons and gamma rays give rise to individual pulses in the three counters, but triple coincidence reduces the chance coincidences enormously. Thus, α detection and the recoil proton spectrum can be obtained. (R.E.U.)

36418 (NP-13020(p.260-4)) SILICON SURFACE BARRIER DETECTORS FOR HIGH RESOLUTION CHARGED PARTICLE SPECTROMETRY. V. C. Srivastava, P. K. Srivastava, and U. C. Gupta (India. Atomic Energy Establishment, Trombay).

A surface-barrier detector is simply a reverse-biased diode. With high-resistivity silicon available now detectors can be made with excellent resolution and risetime. Surface-barrier detectors can be used for the spectrometry of charged particles and neutrons as well as for routine monitoring. The surface-barrier technique was chosen from commonly used methods of making solid-state detectors because of simplicity and obvious advantages. A simple and reliable method of making these detectors is described. (R.E.U.)

36419 (NP-13020(p.265-70)) ION OPTICS OF COMBINED RADIAL ELECTRIC AND INHOMOGENEOUS MAGNETIC FIELDS. V. S. Venkatasubramanian (Indian Inst. of Science, Bangalore).

The variational equation of electron optics is applied to the study of the paraxial imaging and second-order aberration characteristics of the general sector-field mass spectrometer, consisting of superposed, inhomogeneous magnetic and radial electric fields. A mathematical treatment of the variational equation of electron optics is given. (R.E.U.)

36420 (NP-13020(p.271-7)) INVESTIGATIONS ON UNIFORM SPECTRAL SENSITIVITY PHOTON COUNTERS. A. M. Ghose (Bose Research Inst., Calcutta).

An index of uniformity of response U of a counter is given as $U = \bar{\epsilon}[(E_2 - E_1)/(\int_{E_1}^{E_2}(\epsilon - \bar{\epsilon})^2 dE)]^{1/2} - 1$, where ϵ is the efficiency of the counter for photons of energy E lying in the range E_1 to E_2 under investigation and $\bar{\epsilon}$ is the mean efficiency. An analogy is drawn between the problem of energy dependence of the sensitivity of photon counters and the problem of chromatic aberration in optics. Paraxial rays and wide-beam geometry are also discussed. (R.E.U.)

36421 (NP-13020(p.278-81)) A METHOD OF BACKGROUND ERADICATION IN DEVELOPED NUCLEAR EMULSIONS. B. Sen and M. L. Chatterjee (Saha Inst. of Nuclear Physics, Calcutta).

Nuclear emulsion background gains are used quite often in the study of nuclear reactions. In order to obtain good visibility and accurate measurements, background eradication was accomplished using potassium ferricyanide reducer. This has the advantage over other methods in that it can be applied after development. Experimental methods and results are given. (R.E.U.)

36422 (NP-130-20(p.282-4)) SOME DEVELOPMENTS IN NUCLEAR ELECTRONIC INSTRUMENTATION. T. V. A. Subramanian, L. C. Upadhyayulu, S. A. Rangnekar, S. S. Kane, and S. M. Karnad (India. Atomic Energy Establishment, Trombay).

A gamma-ray spectrometer was developed by the Atomic Energy Establishment (Trombay) under a program of transistorized nuclear electronic instrumentation. The advantages of this instrument and a detailed block diagram of the spectrometer and scanner-printer are given. (R.E.U.)

36423 (NP-13020(p.285-8)) INTERNATIONAL INTERCOMPARISON OF Au^{198}. P. K. Srivastava and U. C. Gupta (India. Atomic Energy Establishment, Trombay).

Sources of Au^{198} in the form of aqueous solutions were distributed to participating laboratories for simultaneous measurements. The results of intercomparison by coincidence method and by the $4\pi\beta$ method of activity in microcuries per gram are given. (R.E.U.)

36424 (NP-13020(p.289)) ABSOLUTE STANDARDIZATION OF 250 mc Ra–α–Be NEUTRON EMITTER BY GOLD FOIL ACTIVATION TECHNIQUE. N. C. Jain, M. G. Sahani, and U. C. Gupta (India. Atomic Energy Establishment, Trombay).

The absolute emission rate of a neutron source was determined by measuring the volume integral of the neutron absorption rate in water. The induced activity in irradiated gold foils was measured on a scintillation-type coincidence setup using NaI(Tl) and plastic scintillators for γ and β rays, respectively. Corrections for neutron flux depression, internal conversion, absorption of fast neutrons in oxygen, and self-absorption in the source were applied. (R.E.U.)

36425 (NP-13020(p.290-4)) GETTER ION PUMP FOR METAL SYSTEMS. K. B. Nambiar, J. C. Maliakal, and A. S. Divatia (India. Atomic Energy Establishment, Trombay).

It was found that pressures lower than 1×10^{-6} mm of Hg with a low hydrogen content were required to develop an ion source for producing polarized protons in large metal systems. This low pressure is achieved by incorporating getter-ion pumps either alone or in conjunction with oil diffusion pumps. A getter-ion pump using titanium as getter was developed, and its operational characteristics are investigated. A sketch of the getter-ion pump assembly is shown. The lowest pressure obtained is 4×10^{-6} mm of Hg. (R.E.U.)

36426 (NP-13020(p.295)) ON THE DETAILS OF COUNTING PLATEAU IN GAS FLOW COUNTERS. C. H. Parekh and V. A. Pethe (India. Atomic Energy Establishment, Trombay).

Detailed investigation on the nature of the counting plateau showed that it goes through a negative slope, whereas under normal conditions the slope is always positive. Different types of collectors were used in a gas-flow counter using argon as the detecting medium and Po^{210} as the source of ionization. (R.E.U.)

36427 (NP-13020(p.318-39)) NEUTRON SPECTROMETRY AND INTERATOMIC FORCES. K. R. Rao (India. Atomic Energy Establishment, Trombay).

Neutron spectrometry has yielded information as to the existence of quanta of lattice waves, the phonons, quanta of spin waves, the magnons, and elementary quanta of excitations of rotational nature in quantum liquids like helium II, the rotons. The Born-VonKarman theory of lattice dynamics is followed in a force-constant analysis of lead, sodium, and aluminum. Harmonic force analysis is applied to cubic crystals, force constants are given for each analysis, and dispersion curves were calculated on the basis of

a central force model. The broad features of several aspects of the nature, complexity, and magnitude of interatomic forces are presented by neutron spectrometry. No functional formulation of interatomic forces was arrived at because only a very few solids were studied. (R.E.U.)

36428 (NP-13020(p.340-5)) LATTICE DYNAMICS OF HEXAGONAL CLOSE-PACKED LATTICES AND DISPERSION RELATIONS FOR MAGNESIUM. P. K. Iyengar, G. Venkataraman, P. R. Vijayaraghavan, and A. P. Roy (India. Atomic Energy Establishment, Trombay).

The results of an investigation in magnesium, a polyvalent metal of the hexagonal close-packed (HCP) type are given. Of the various HCP metals, magnesium is interesting since it has a c/a ratio only slightly less than the ideal resulting in a large measure of isotropy in the elastic properties. It is concluded that a short range central force model is able to reproduce the features of the observed phonon spectrum in magnesium. (R.E.U.)

36429 (NP-13020(p.346-53)) NEUTRON SCATTERING FROM MOLECULAR CRYSTALS. Usha Deniz, G. Venkataraman, P. K. Iyengar, P. R. Vijayaraghavan, and A. P. Roy (India. Atomic Energy Establishment, Trombay).

Results obtained by neutron inelastic scattering from NH_4Br and NH_4I at 100°K and at 300°K are used to study molecular vibrations in these crystals. The energy of the torsional level is investigated for both the bromide and iodide spectra. The vibrational spectra are given graphically for both halides at 100°K and at 300°K. (R.E.U.)

36430 (NP-13020(p.353-69)) RECENT MAGNETIC STRUCTURE STUDIES BY NEUTRON DIFFRACTION. N. S. Satya Murthy (India. Atomic Energy Establishment, Trombay).

Study of magnetic materials by neutron diffraction is by far the most powerful use of available thermal neutron fluxes. The magnetic properties of the rare earth metals and of chromium are discussed, including cerium-58, neodymium-60, terbium-65, dysprosium-66, holmium-67, erbium-68, and thulium-69. (R.E.U.)

36431 (NP-13020(p.370-6)) NEUTRON DIFFRACTION AND PROTON MAGNETIC RESONANCE STUDY OF THE SPACE GROUP AND STRUCTURE OF POTASSIUM OXALATE MONOHYDRATE. R. Chidambaram, A. S. Sequeira, and S. K. Sikda (India. Atomic Energy Establishment, Trombay).

A new method of determining space groups using proton magnetic resonance, which is applicable in some cases, is proposed, and its use to identify the space group of $K_2C_2O_4 \cdot H_2O$ is shown. The hydrogen positions obtained from the neutron-diffraction structure analysis are in good agreement with the N.M.R. results. The calculated values for the constants of the p-p vector are: $r = 1.56$ Å; $\phi_0 = 45.5°$. (R.E.U.)

36432 (NP-13020(p.377-83)) ELECTRON DIFFRACTION STUDY OF CRYSTALLINE BARIUM CHLORIDE DIHYDRATE $BaCl_2 \cdot 2H_2O$. V. M. Padmanabhan, V. S. Jakkal, and Jagdish Shankar (India. Atomic Energy Establishment, Trombay).

The techniques of structure analysis are applied to electron-diffraction data. Structure factors and atomic parameters are given. (R.E.U.)

36433 (NP-13020(p.392-400)) FREQUENCY DISTRIBUTION OF ATOMIC VIBRATIONS IN SOLIDS AND RESONANT ABSORPTION OF SLOW NEUTRONS. K. R. Rao and C. L. Thaper (India. Atomic Energy Establishment, Trombay).

The derivation of a formula for total cross section at a resonance by the "phonon-expansion" method is presented. Resonance shape in samples such as Ir, In^{115}, Sm^{149}, Hf^{177}, Pu^{240}, Ta, and W is studied on a single-crystal neutron spectrometer, and a crude model for the frequency distribution is obtained from the analysis. Preliminary results on the 0.654-ev resonance in Ir^{191} are also presented. (R.E.U.)

36434 (NP-13020(p.401-20)) ISOTOPE EFFECT IN OPTICAL SPECTRA. N. A. Narasimham (India. Atomic Energy Establishment, Trombay).

Differences in wave lengths of lines emitted by isotopes of the same element arise as a result of differences in (1) the masses of isotopes and (2) their charge distributions. Rotation, vibration, and spin effects are discussed. It is concluded that, in general, the observed isotope shifts agree with the predicted values. The slight discrepancies that remain require detailed investigations of the anharmonicity terms, interactions due to electronic and nuclear motions, and other coupling phenomena. (R.E.U.)

36435 (NP-13020(p.423-41)) INTERPRETATION OF NUCLEAR SPIN-SPIN COUPLING CONSTANTS IN MOLECULES. P. T. Narasimhan (Indian Inst. of Tech., Kanpur).

Both molecular orbital and valence bond wave functions were used with perturbation theory or variational approach for calculating the sign and magnitude of the coupling constant $J_{NN'}$ for two magnetic nuclei N,N'. The study of nuclear spin coupling constants in molecules is of help in understanding the electron spin-nuclear spin and nuclear spin-nuclear spin correlation in molecules. (R.E.U.)

36436 (NP-13020(p.448-50)) NEIGHBOR ANISOTROPY EFFECT IN NUCLEAR MAGNETIC SHIELDING. A. Mukherjee and M. Karplus (Columbia Univ., New York).

The relation between the dia- and paramagnetic components of the magnetic shielding and corresponding components of the susceptibility is studied. It was possible to obtain a gauge function which maintains the same relation between the components as that existing between the total shielding and the susceptibility anisotropy. The advantage is given for using this gauge function for deriving the shielding components from the susceptibility. (R.E.U.)

36437 (NP-13020(p.451-3)) THEORETICAL FORMULATION OF DIAMAGNETIC SUSCEPTIBILITY AND NUCLEAR MAGNETIC SHIELDING IN MOLECULES. A. K. Raychaudhuri and S. K. Sinha (Saha Inst. of Nuclear Physics, Calcutta).

A form of the vector potential was proposed which would reduce the second-order paramagnetic parts of both molecular diamagnetic susceptibility and nuclear magnetic shielding to zero. (R.E.U.)

36438 (NP-13220(p.454-9)) GENERALIZED EXPRESSION FOR THE DYNAMIC NUCLEAR POLARIZATION. P. Parikh and B. Sain (Punjab Univ., Chandigarh, India).

An expression is developed for the dynamic nuclear polarization attained for the case of a nuclear system of any arbitrary spin when the electronic system is simultaneously saturated. (R.E.U.)

36439 (NP-13020(p.460-5)) AN E.S.R. SPECTROMETER WITH A CO-AXIALLY FED CAVITY. R. Roy and A. K. Saha (Saha Inst. of Nuclear Physics, Calcutta).

The successful design and construction of one ESR spectrograph employing 100 kc/s field modulation and the phase-sensitive detection scheme are reported. A block diagram of the spectrograph and of the coaxially fed cavity is shown. Typical photographs of DPPH signal as recorded in the crystal-video system and the pen-recorder trace of the derivative of the absorption signal obtained after phase-sensitive detection are presented. (R.E.U.)

36440 (NP-13061) PROGRESS REPORT [ON RESEARCH], MARCH–MAY 1963. (Illinois. Univ., Urbana. Coordinated Science Lab.). June 15, 1963. Contract DA-36-039-TR US AMC-02208(E). 89p.

Research progress on electric vacuum gyroscopes, surface and atomic physics, computers, system theory (graph, network, etc.), automatic teaching systems (PLATO), vacuum instrumentation, plasma physics, high magnetic field superconductors, vacuum electrical breakdown, physical electronics, and arms control and disarmament is reported. (D.C.W.)

36441 (NP-13071) THE HYDROMAGNETICS OF AN ELLIPSOID MOVING IN A CROSS-FIELD. Technical Report No. 4. G. S. S. Ludford and M. P. Singh (Cornell Univ., Ithaca, N. Y.). July 1963. Contract Nonr-401(46). 21p.

The motion (x) of an arbitrary ellipsoid ($x^2/a^2 + y^2/b^2 + z^2/c^2 = 1$) through an incompressible, inviscid, electrically conducting fluid in a transverse magnetic field (z) is treated by linearized equations. It is found that a non-conducting ellipsoid will allow the fluid to pass through its cylinder to some extent, but will also force the fluid to go around it. A conducting ellipsoid will behave like a very tall (c large) non-conducting one and will force all the fluid to go around; if it is very wide (b large), it will carry a considerable amount of fluid with it. Flow patterns are shown. (D.C.W.)

36442 (NP-13084) RESEARCH INVESTIGATION DIRECTED TOWARD EXTENDING THE USEFUL RANGE OF THE ELECTROMAGNETIC SPECTRUM. Quarterly Progress Report No. 2, March 16, 1963 through June 15, 1963. R. Novick (Columbia Univ., New York. Columbia Radiation Lab.). June 15, 1963. Contract DA-36-039-SC-90789. 66p.

The nuclear spin and magnetic moment of 55-hour Cd^{115} were determined by optical double resonance. Positive identification of the isotope was obtained by the observation of the decay of the resonances. The atomic g factor for the $(5s5p)^3P_1$ state of Cd was determined to 10 ppm with a K-band optical double resonance spectrometer. Metastable autoionizing states were discovered in potassium and rubidium, and it has been shown that these can be quenched with an electric field (Stark quenching). The hyperfine structure of the $(4s4p)^3P_1$ state of Zn^{67} was redetermined. Level crossings were detected in the $(3d)^54p$ and $(3d)^44s4p$ configurations of chromium; the lifetimes of these states were determined from the widths of the crossing resonances. The spin lattice relaxation rate for He^3 nuclei in solid He^3 was calculated, and the results compare favorably with experiment. A new, low temperature, Q-switched ruby laser was constructed as the excitation source for a photon echo experiment. A cryostat for the ENDOR spectrometer, which permits the sample to be cooled to liquid hydrogen temperature, was built and operated successfully. The hyperfine interaction of the Ag^0 center in KCl with the neighboring chlorine ions was resolved by the ENDOR technique at liquid hydrogen temperatures. A new laser spectrometer was constructed and tested. This is to be used for the study of photon-phonon interactions in liquids and solids. A sensitive high pressure microwave absorption spectrometer was constructed and used for the study of the absorption in CO_2. Detailed study of the microwave absorption of various gases present in planetary atmospheres is required for the full interpretation of the results that were obtained by interplanetary radar. (auth)

36443 (NP-13089) CURRENT INDUCED SWITCHING OF SUPERCONDUCTIVE THIN FILMS. Frederick W. Schmidlin, Arthur J. Learn, Eugene C. Crittenden, Jr., and John N. Cooper (Space Technology Labs., Inc. Physical Research Lab., Los Angeles). June 15, 1960. 30p.

Currents required to cause superconducting to normal transitions of thin films were measured as a function of temperature for various widths and thicknesses. Normal to superconducting transition times for the same films were also measured as a function of the magnitude of drive current. In spite of the lack of a satisfactory theoretical model for the initiation of the transition, the bulk of the results can be understood in terms of temperature changes in the film, as governed by factors limiting the flow of heat (generated subsequent to the initial transition) into the substrate and liquid helium bath. (auth)

36444 (NP-13090) SUPERCONDUCTIVE PROPERTIES OF VACUUM DEPOSITED INDIUM FILMS. Frederick W. Schmidlin, Arthur J. Learn, Eugene C. Crittenden, Jr., and John N. Cooper (Space Technology Labs., Inc. Physical Research Lab., Los Angeles). [nd]. Contract NONR-2542(00). 71p. (PRL-9-18)

The transition of superconducting films to the normal state as the current in them reaches a critical value was studied. After a brief description of sample preparation and measurement techniques, information on the dependence of the critical current and transition time on temperature, type of film substrate (quartz or glass), and film width and thickness is presented. Transition time dependence on the amplitude of the current pulse is also shown. (D.C.W.)

36445 (NYO-10106) SINGLE AND DOUBLE DEFORMATION FAULTS IN FACE CENTERED CUBIC CRYSTALS. B. E. Warren (Massachusetts Inst. of Tech., Cambridge). Jan. 1963. Contract AT(30-1)-3020. 7p.

The diffraction effects of a double deformation fault (extrinsic fault) are readily derived for small faulting probabilities by using a faulted sequence with a layer added and subtracted. Let α' and α'' be the probabilities for single and double deformation faults. If both types of faulting are present with α' and α'' both small and independent, the peak broadening depends upon $\alpha' + \alpha''$, the peak shift depends upon $\alpha' - \alpha''$, and there is a peak asymmetry proportional to α'' which is similar to that produced by twin faulting. (auth)

36446 (PIBMRI-1073-62) ON DIFFRACTION BY OBJECTS IN A UNIAXIALLY ANISOTROPIC MEDIUM. Memorandum 83. L. B. Felsen (Brooklyn. Polytechnic Inst. Microwave Research Inst.). Aug. 14, 1962. 11p. Contract AF19(604)-4143. 11p. (AD-294496)

The scattering of electromagnetic waves by conducting cylindrical objects in a gyrotropic medium with the gyrotropic axis parallel and perpendicular to the scatterer axis is treated. Connections that permit the direct construction of solutions of two-dimensional diffraction problems in the uniaxially anisotropic medium from corresponding conventional solutions in isotropic regions are established. Diffraction by objects of other shapes (wedges, etc.) in anisotropic media is also shown to reduce to isotropic diffraction. Preliminary results of an investigation of the effects of surface curvatures and edge singularities on the high-frequency diffraction field in anisotropic regions are included. (D.C.W.)

36447 (RADC-TDR-62-464(Vol.2)) INVESTIGATION OF MHD POWER GENERATION. VOLUME II. INVESTIGATION WITH CROSSED-FIELD MICROWAVE DEVICES. W. C. Brown (Raytheon Co. Spencer Lab., Burlington, Mass.). June 30, 1962. For Pratt and Whitney Aircraft Div., United Aircraft Corp., Middletown, Conn. Contract

AF30(602)-2487, Subcontract No. 2. 147p. (PT-335; AD-294321)

The electromagnetic amplifying lens (EAL) proved to be the most promising crossed-field device for microwave power generation from a primary power source (notably, a magnetohydrodynamic generator), and a theoretical investigation of the EAL concept was followed by a limited amount of cold test work on the EAL anode. Design studies were performed for 10 and 1000-Mw X-band devices, and generation of power in the short millimeter region was also considered. (D.C.W.)

36448 (SC-4790(RR)) SUMMARY OF PYROTECHNIC DELAY INVESTIGATIONS FOR THE AEC AND SANDIA CORPORATION. Raymond H. Comyn (Harry Diamond Labs., Washington, D. C.). Sept. 1963. For Sandia Corp., Albuquerque, N. Mex. Contract [AT(29-1)-789]. 21p.

Investigations of component and process specification for the UMNOL pyrotechnic delay mixture are described. (auth)

36449 (TID-17986) IMPERFECT BOSE GAS. Kerson Huang (Massachusetts Inst. of Tech., Cambridge). Feb. 13, 1963. Contract AT(30-1)-2098. 158p.

The equation of state of a class of imperfect Bose gases is calculated and examined in the first and second approximations. The cases of a hard sphere potential and of attractive interactions in which the attraction is sufficient to produce a gas-liquid condensation are considered. Both macroscopic and microscopic properties are examined, as are the consequences for liquid helium. (D.C.W.)

36450 (TID-19275) NUCLEAR QUADRUPOLE COUPLING STUDIES IN SOLIDS. Progress Report. (Rensselaer Polytechnic Inst., Troy, N. Y.). May 1963. Contract AT(30-1)-3030. 8p.

Investigations of $AlCl_3$ and BF_3 were completed, and abstracts of two papers on these investigations are presented. Progress is reported for several other investigations, and preliminary results are summarized for the effects of Co^{60} gamma rays on sodium chlorate and paradichlorobenzene. (D.L.C.)

36451 (TID-19296) IONIZATION AND CHARGE TRANSFER CROSS SECTIONS. SUMMARY OF RESULTS FOR FAST HELIUM IONS. Technical Status Report No. 15, June 1, 1961–May 31, 1963. R. A. Langley, D. W. Martin, D. S. Harmer, J. W. Hooper, and E. W. McDaniel (Georgia Inst. of Tech., Atlanta. Engineering Experiment Station). June 1, 1963. Contract AT(40-1)-2591. 108p.

The cross sections for the production of slow positive ions and free electrons by He^+ ions incident on He, Ne, Ar, H, N, O, and CO were measured at incident particle energies of 0.133 to 1.00 Mev; and the corresponding cross sections for He^{2+} on He and H at 0.50 to 1.00 Mev were measured. Theoretical aspects and the experimental apparatus and procedures are discussed, and the results are compared with available theory. (D.C.W.)

36452 (TID-19303) SORPTION OF GASES ON METAL SURFACES IN ULTRAHIGH VACUUM. Annual Report, February 15, 1962–February 14, 1963. R. A. Pasternak and B. W. Bergsnov-Hansen (Stanford Research Inst., Menlo Park, Calif.). Contract AT(04-3)-425. 32p.

An ultrahigh vacuum system was developed for the study of evaporated films, and its testing and calibration are described. A r-f quadrupole mass spectrometer was designed. Coated ion gage filaments were made for operation at lower temperatures. (D.L.C.)

36453 (TID-19310) PROPERTIES OF HARD SUPERCONDUCTOR TO NORMAL METAL CONTACTS (thesis). Donald Barrett Sullivan (Vanderbilt Univ., Nashville. Graduate School). June 1963. 45p.

The voltage-current characteristics of Nb–Zr alloy (various compositions) and cold-drawn Nb contacts to Cu, In, Al, Zn, and Sn were studied as a function of temperature below the transition temperature of the superconductors. Experimental procedures, equipment, and results are described; and explanations for the observed characteristics are investigated. The observed characteristics were concluded not to result from a heat or temperature phenomenon. (D.C.W.)

36454 (TID-19348) THE IONIZATION OF ALKALI IONS BY ELECTRON IMPACT. Quarterly Technical Progress Report No. 3, June 1, 1963–August 31, 1963. J. W. Hooper, E. W. McDaniel, and W. C. Lineberger (Georgia Inst. of Tech., Atlanta. School of Electrical Engineering). Sept. 1, 1963. Contract AT(40-1)-3027. 5p.

D-c and modulated beam experiments are being planned for measuring the cross section for ionization of Li^+ ions by electron impact at threshold to 1000 ev. The development of electron and ion sources for the experiments is described. (D.L.C.)

36455 (TRW-ER-5464) HIGH TEMPERATURE SOLAR THERMIONIC GENERATORS. First Quarterly Technical Progress Report, April 15, 1963–July 31, 1963. (TAPCO. Div. of Thompson Ramo Wooldridge Inc., Cleveland). Aug. 15, 1963. Contract AF33(657)-11169. 50p.

Progress is reported on work accomplished on applied research initiated on cesium-vapor thermionic converters. The two major goals of the program are: to demonstrate that cesium-vapor thermionic converters operating above 1600°C can have a satisfactory life of at least one year at efficiencies greater than 15% and at power densities greater than 12 watts/cm^2; and to demonstrate that such high-temperature converters can be incorporated into a cavity generator capable of sustained operation at the focal point of a solar concentrator. Toward these goals, a cavity type generator was extensively tested under a solar flux range of 80 to 100 watts/ft^2 during the first quarter of the program and good correlation of the generator solar performance with previous laboratory performance has been obtained. Further, an advanced thermionic converter design, fabrication and performance evaluation was successfully accomplished and an additional three converters of this configuration are undergoing fabrication. These converters will be subjected to sustained and cyclic life evaluations during the second and third quarter of the program. (auth)

36456 (UCRL-10878) A GENERALIZED OPTICAL-POTENTIAL METHOD AND ITS APPLICATION TO THE SCATTERING OF ELECTRONS BY ATOMIC HYDROGEN. (thesis). Robert Ta-Pang Pu (California. Univ., Berkeley. Lawrence Radiation Lab.). June 18, 1963. Contract W-7405-eng-48. 76p.

A generalized optical-model-potential method for calculation of the scattering of charged particles by atoms is described. The method is shown to combine, in practical applications, the advantages of two conventional approaches, the eigenfunction expansion method and the optical-potential method, and to contain these two approaches as limiting cases. With certain modification to allow for the Pauli exclusion principle explicitly, the method is applied to the elastic scattering of the electrons by hydrogen atoms for energies below the excitation of the second quantum level (10.2 ev), with 1s, 2s, 2p hydrogen atomic states used in the close-coupling scheme. The resulting coupled set of integro-differential equations, with appropriately approximated generalized optical potentials, was integrated nu-

merically on an IBM 7090 computer, yielding phase shifts in various total spin and total angular momentum states. Results from this calculation are compared with other theoretical predictions and available experimental data. The short-range interelectron correlation effect is found to be of major importance for S-wave scattering in the entire energy range except very near zero energy. The influences of the long-range polarization potential and the short-range effect become comparable for P-waves. For D-waves, the long-range polarization potential begins to assume a major role in the scattering, and for F and higher waves it becomes singularly dominant throughout. Extremely narrow resonance-type effects in phase shifts of various spin and angular momentum states are found at energies slightly below the second quantum level. The resonance in singlet S-state is analyzed in detail, by a Breit-Wigner type fit, and is found to be centered at 9.51 ev with a narrow full width of 0.067 ev. For the scattering length of singlet S-wave, a value of 6.520 (in unit of Bohr radius) is obtained. The method is less successful in singlet low-angular-momentum waves where short-range oorrelation effect is important. A modified trial wave-function form is suggested for these cases, to take better account of the mutual repulsion between electrons. 33 references. (auth)

36457 (UCRL-10891) THE DUBIOUS ROLE OF THE SPACE-TIME CONTINUUM IN SUBATOMIC PHYSICS. Geoffrey F. Chew (California. Univ., Berkeley. Lawrence Radiation Lab.). June 27, 1963. Contract W-7405-eng-48. 17p.

Attention is called to the quantum-relativistic principles that preclude an experimental significance for space and time on the nuclear scale, and an historical review attempts to explain why the space-time continuum nonetheless has remained until now the basis for nuclear theory. A survey is given of the current trend toward development of a theory based on an energy-momentum continuum, with space-time employed only in a large-scale coarse-grained sense. (auth)

36458 (AEC-tr-5978) EXCHANGE INTERACTION BETWEEN THE CONDUCTION ELECTRONS OF A SUPERCONDUCTOR AND PARAMAGNETIC IONS. Walter Baltensperger. Translated for Ames Lab., Ames, Iowa from Helv. Phys. Acta, 32: 197-212(1959). 17p.

Effects due to the exchange interaction between superconducting electrons and dissolved paramagnetic ions are studied, using the theory of Bardeen, Cooper, and Schrieffer for the electrons, and the model of Herring for the interaction. The critical temperature of the superconductor decreases almost linearly with the concentration of the ions. The phase transition is of the first kind. In the normal state the system is ferromagnetic with a Curie-point proportional to the concentration. The theory is compatible with the measurements of Matthias, Suhl, and Corenzwit on a La alloyed with rare earths, and those of Jean Müller on V with transition metals. In a range of concentrations the superconductor, having disordered ion-spins, makes a transition into a normal ferromagnetic phase at low temperatures. This will not happen, if the superconductor has a spin susceptibility in accordance with the measurements of Reif, because this allows an ordering of the spins. 29 references. (auth)

36459 CALCULATION OF ATOMIC SCATTERING FACTORS FOR THE HELIUM ATOM BY MEANS OF THE SIX-TERM HYLLERAAS WAVE FUNCTION. M. L. Rustgi, M. M. Shukla, and A. N. Tripathi (Banaras Hindu Univ., Varanasi, India). Acta Cryst., 16: 926-8(Sept. 10, 1963). (In English)

Atomic scattering factors were calculated for the helium atom by means of the six-term Hylleraas wave function. The results are in good agreement with previous calculations. (auth)

36460 ADVANCES IN ELECTRONICS AND ELECTRON PHYSICS. VOLUME 17. L. Marton, ed. Adv. Electron. Electron Phys., 17: 1-451(1962). New York, Academic Press, 1962. $14.00.

Five main topics are presented including the general perturbational theory of space-harmonic traveling-wave electron interaction, thermionic energy conversion, thermoelectricity, impact evaporation and thin film growth in a glow discharge, and ultrahigh vacuum. Separate abstracts are prepared for each of the five sections. (C.E.S.)

36461 THE GENERAL PERTURBATIONAL THEORY OF SPACE-HARMONIC TRAVELING-WAVE ELECTRON INTERACTION. W. G. Dow (Univ. of Michigan, Ann Arbor). Adv. Electron. Electron Phys., 17: 1-123(1962).

Small-signal equations for traveling-wave interaction of an electron beam with an adjacent space-harmonic circuit are developed, including the effects of competition between the first forward space harmonics of the forward and backward total waves on the circuit. Three conceptual aspects of this interaction are considered including the electrokinetic effect of the space-harmonic electric field in bunching the beam, the propagational attributes of the circuit as a whole, and the coupling influences via the electromagnetic field between the circuit and the bunched beam. A very simple circuit model is used for illustrative purposes. (C.E.S.)

36462 THERMIONIC ENERGY CONVERSION. J. M. Houston and H. F. Webster (General Electric Research Lab., Schenectady, N. Y.). Adv. Electron. Electron Phys., 17: 125-206(1962).

A brief summary of thermionic conversion analysis is presented. Equations for the current-voltage characteristics, power output, and efficiency of an idealized model of a thermionic converter are derived. The work functions of the surface of various materials and combinations of materials are discussed. The space charge, surface physics, and fabrication problems of vacuum thermionic energy converters are outlined. Cesium thermionic energy converters and devices using auxiliary discharges and fission fragments for ion production are discussed along with their applications. (C.E.S.)

36463 THERMOELECTRICITY. Frank E. Jaumot, Jr. (General Motors Corp., Kokomo, Ind.). Adv. Electron. Electron Phys., 17: 207-43(1962).

A review of the principles involved in thermoelectricity is presented with particular emphasis on gaps in the present knowledge of the phenomenon. The materials systems of greatest interest and the approximate temperature at which the system appears to be most useful are reported. The figure of merit, materials fabrication, and device design are considered. The theoretical parameters involved and their effects on thermoelectric cell development are discussed. Applications of the thermoelectric cells are also considered. (C.E.S.)

36464 IMPACT EVAPORATION AND THIN FILM GROWTH IN A GLOW DISCHARGE. Eric Kay (International Business Machines Corp., San Jose, Calif.). Adv. Electron. Electron Phys., 17: 245-322(1962).

The impact evaporation or cathode sputtering process is described and the important parameters of this process are discussed with respect to thin film nucleation and growth in a glow discharge environment. Emission of charged particles from metal surfaces by energetic particles, high-

vacuum impact evaporation, glow discharge characteristics, and reactive impact evaporation are also considered. (C.E.S.)

36465 ULTRAHIGH VACUUM. P. A. Redhead, J. P. Hobson, and E. V. Kornelsen (National Research Council, Ottawa). Adv. Electron. Electron Phys., 17: 323-431 (1962).

The processing methods, materials, and techniques used in obtaining ultrahigh vacuums are reviewed. Various physical processes that control the behavior of sources and sinks of gas and effect the measurement of pressure are discussed. Methods of production and measurement of ultrahigh vacuums are described. The applications of the ultrahigh vacuum techniques are outlined. (C.E.S.)

36466 USE OF ELECTRODELESS DISCHARGE LAMPS IN THE ANALYSIS OF ATOMIC SPECTRA. Earl F. Worden (Univ. of California, Livermore), Ralph G. Gutmacher, and John G. Conway. Appl. Opt., 2: 707-13(July 1963). (UCRL-7199-T)

The application of electrodeless discharge lamps in obtaining the information necessary for the analysis of the first and second spectra of lanthanide and actinide elements is discussed. It is shown how differentiation of neutral-atom and first-ion lines, self-reversal, and Zeeman-effect observations may be procured using these lamps as the sole source. The procedures are illustrated by studies on Cm, Gd, and Dy. (auth)

36467 SPECTROSCOPIC INVESTIGATION OF A THERMIONIC CAPILLARY CESIUM ENERGY CONVERTER. R. T. Schneider and J. D. Dunlop (General Motors Corp., Indianapolis). Appl. Phys. Letters, 3: 73-5(Sept. 1, 1963).

A thermionic capillary cesium energy converter operating in the power generating region was investigated by means of spectroscopy. Spectra were presented for the four modes of operation: passive mode, oscillating region, ignited mode, and arc mode. The electron density, estimated by spectral line broadening measurements, was 2×10^{14} per cm^3. The electron temperature was determined by measurements of intensity ratios of lines originating from high energy levels. (C.E.S.)

36468 FLUX TRAPPING IN HOLLOW SOFT SUPERCONDUCTING CYLINDERS. D. L. Coffey (Oak Ridge National Lab., Tenn.), W. F. Gauster, and H. E. Rorschach, Jr. Appl. Phys. Letters, 3: 75-6(Sept. 1, 1963).

Flux trapping measurements in hollow superconducting lead cylinders were undertaken to determine whether the reduction in trapped field is due to the length of the cylinder or whether even an infinitely long cylinder would display similar behavior. An infinitely long hollow cylinder was simulated by arranging a niobium guard ring at each end of the cylinder. The experiments seem to indicate that magnetic fields as large as the critical field may be stably trapped in soft superconducting cylinders. (C.E.S.)

36469 DEGRADATION AND FLUX JUMPING IN SOLENOIDS OF HEAT-TREATED Nb–25% Zr WIRE. M. S. Lubell, B. S. Chandrasekhar, and G. T. Mallick (Westinghouse Research Labs., Pittsburgh). Appl. Phys. Letters, 3: 79-80(Sept. 1, 1963).

Evidence is presented that the excessive degradation of critical current that occurs in solenoids wound from heat-treated Nb–25% Zr wire is due to the simultaneous presence of transport current and flux jumping. A uniform magnetic field was applied to the solenoid and increased smoothly from zero with no transport current in the solenoid. A sequence of very narrow voltage pulses was recorded across the terminals of the solenoid. From the characteristics of the voltage pulses it is concluded that the critical current in zero external field is determined by a critical combination of applied current and self-field that corresponds to a point at which a major flux jump occurs. (C.E.S.)

36470 SUPERCONDUCTIVITY OF TWO-PHASE Nb–Nb_2Sn_3 SINTERED COMPACTS. R. E. Enstrom, G. W. Pearsall, and J. Wulff (Massachusetts Inst. of Tech., Cambridge). Appl. Phys. Letters, 3: 81-2(Sept. 1, 1963).

The superconducting properties of two-phase sintered compacts containing Nb_2Sn_3 and Nb solid solution were investigated. The transition temperature, the transverse critical field, and critical current density were determined. The properties of single-phase and two-phase compacts were compared. (C.E.S.)

36471 EFFECT OF RELATIVISTIC VARIATION OF ELECTRON MASS ON HARMONICS IN THE SCATTERING OF LIGHT BY FREE ELECTRONS. N. C. Rastogi and Vachaspati (Univ. of Lucknow, India). Indian J. Pure Appl. Phys., 1: 311-13(Sept. 1963).

The scattering cross sections of light by free electrons into the first two harmonics are evaluated neglecting the variation of the electron mass with velocity. It is observed that while the scattering cross section for the second harmonic is unaltered, the intensity-dependent terms in the cross section for scattering into the principal mode are unexpectedly different. (auth)

36472 MOTION OF PARTICLES IN CENTRAL BY SYMMETRIC STATIC FIELD IN GENERAL THEORY OF RELATIVITY. S. L. Galkin (Moscow State Univ.). Izv. Vysshikh Uchebn. Zavedenii, Fiz., No. 3, 54-62(1963). (In Russian)

A qualitative method was developed for determining the motion of particles in a centrally symmetric static field without resolving the corresponding trajectorial differential equations. Solutions for trajectory equations were found for particles in Schwarzschild and Nordstrom fields and for neutrino-type massless particles inside a liquid sphere. It was found that particles with identical energies and moments move in different regions depending on their original position. (tr-auth)

36473 RELATIVE PARTIAL WAVE THEORY OF DIATOMIC MOLECULES. A. Temkin (Goddard Space Flight Center, Greenbelt, Md.). J. Chem. Phys., 39: 161-9 (July 1, 1963).

The method of expanding the Hamiltonian in (relative) partial waves and introducing similarly expanded but truncated series as approximate solutions was utilized in the case of $(H_2)^+$ as a prototype of diatomic molecules. Thirteen states were examined at four internuclear separations and results compared to exact results. In particular, oscillator strengths were computed, and various properties of the approximate solutions are exhibited, which make this method potentially very useful especially for some astrophysical applications. A simple modification of the theory can be made, which ensures that the oscillator strengths satisfy the sum rules. (auth)

36474 RADIOTRACER MEASUREMENT OF THE DESORPTION ENERGY OF SILVER FROM MOLYBDENUM AND NICKEL. E. von Goeler and R. N. Peacock (Univ. of Illinois, Urbana). J. Chem. Phys., 39: 169-74(July 1, 1963).

When Cd^{107} undergoes decay by electron capture, the radioactive daughter Ag^{107m} is given sufficient energy by neutrino recoil to enable it to escape from adsorbed sites. Sources of Cd^{107} were made of sufficient strength and cleanliness to enable use of the recoiling Ag^{107m} as a very pure beam of tracer atoms to study surface interactions

of silver with thermally cleaned polycrystalline foils of molybdenum and nickel. Constant beams of Ag^{107m} with intensities greater than 10^6 particles per minute were attained in 1% geometry. The desorption energy of silver on molybdenum was found to be 1.9 ± 0.3 ev, and of silver on nickel, 1.6 ± 0.3 ev. All measurements were made under ultra-high-vacuum conditions, and techniques were developed to permit using a volatile isotope in a baked-out system. (auth)

36475 SOME EXPERIMENTAL OBSERVATIONS OF THE CHARACTERISTICS OF HYDROMAGNETIC IONIZING FRONTS. M. H. Brennan, I. G. Brown, D. D. Millar, and C. N. Watson-Munro (Univ. of Sydney). J. Nucl. Energy, Pt. C, 5: 229-34(July-Aug. 1963). (In English)

Results are presented of a series of systematic observations on the effects of density, magnetic field, and driving current on the characteristics of a hydromagnetic ionizing front propagated in several light gases. Over the range where theory applies these results are compared with theoretical predictions. (auth)

36476 IONIZING RADIATIONS EXCITED IN A POSITIVE BURST PULSE CORONA IN HYDROGEN. Tikawo Tamura (Shizuoka Univ., Hamamatsu, Japan). Japan. J. Appl. Phys., 2: 492-9(Aug. 1963). (In English)

The onset of a positive-burst pulse corona was measured at different pressures in hydrogen. From the extrapolated value of reduced field strength to indefinitely high pressure the effective absorption coefficient of the radiation active in the formation of a positive burst pulse corona was deduced. The estimated values differ for different values of the field strength at the tip of the positive electrode. It seems that there are at least three components of radiation with values of absorption coefficient μ_{760} 0.095, 215, and 1500 cm^{-1} active at values of E/p_0 around 23 to 31, 110 to 660, and 1000 and 9600 volt cm^{-1} $Torr^{-1}$ respectively. Ratios of numbers of ionizing photons to ions, as well as excitation coefficient, were calculated for these components. A possible explanation for the excitation of the most penetrative component was also presented. (auth)

36477 PRECISION NONDESTRUCTIVE TESTING OF THERMOELECTRIC MATERIALS. S. H. Fitch and J. W. Morris (Atomics International, Canoga Park, Calif.). Nondestructive Testing, 21: 306-10(Sept.–Oct. 1963).

The direct conversion of heat to electrical energy and the application of this (thermoelectric phenomenon to Systems for Nuclear Auxiliary Power (SNAP) for space vehicles is discussed. The development of a complete quality control system for the evaluation of thermoelectric materials, as-received, in-process, and after assembly, is outlined. The contributions of nondestructive testing and statistical quality control in enhancing the assurance of acceptable quality and reliability of the end product are demonstrated by actual test records and control charts. (auth)

36478 STUDY OF ORDERING IN MAGNETIC ISOTROPIC AND ANISOTROPIC NICKEL ALLOYS WITH THE MÖSSBAUER METHOD. W. Zinn (Siemens and Halske AG, Munich), M. Kalvius, E. Kankeleit, P. Kienle, and W. Wiedemann. Phys. Chem. Solids, 24: 993-1002(Aug. 1963). (In German)

The hyperfine-structure of the 14.4 kev-γ-transition in Fe^{57} was measured by the Mössbauer effect in foils of ordered and disordered Ni_3Fe and in Permalloy films (81% Ni, 19% Fe) with and without uniaxial magnetic anisotropy. The magnetic field at the iron nucleus was determined from the separation of the hyperfine lines. The broadening and the asymmetrical form of the measured lines can be explained by a spectrum of hyperfine fields resulting from statistical fluctuations in the microenvironments of the iron atoms. In the ordered Ni_3Fe the broadening of the resonance lines was appreciably reduced. No differences were found for the width and the form of the hyperfine lines in Permalloy films with and without uniaxial magnetic anisotropy; the number of directed iron pairs in films with uniaxial magnetic anisotropy is shown to be smaller than 10^{20} pairs/cm^3. (auth)

36479 CORRECTIONS TO THE GROUND STATE ENERGIES OF SHALLOW DONORS IN SILICON AND GERMANIUM. P. Csavinszky (Texas Instruments Inc., Dallas). Phys. Chem. Solids, 24: 1003-10(Aug. 1963). (In English)

The correct potential in the effective mass equation should be the difference of the potential of a donor in the solid and that of an atom of the semiconductor host crystal. Such a difference potential is constructed for the central-cell region (defined by a sphere of radius of half the nearest neighbor distance), by making use of the Thomas-Fermi statistical theory, and considered as a perturbation to the potential (a simple Coulomb potential shielded by the static dielectric constant of the semiconductor) of the uncorrected theory. Using first-order perturbation theory, the energy corrections are computed and the ground state energies of P, As, Sb, and Bi in Si and Ge are found to be (the minus signs are not denoted) 31, 35, 39, 45 Mev and 8.9, 9.3, 9.6, 10.0 Mev, respectively, representing a definite improvement over the values of 29 Mev and 9.2 Mev which were predicted for all donors in Si and Ge, respectively, by the uncorrected theory. The possible sources of the still remaining discrepancies between theoretical and experimental values are discussed and attributed partly to effects outside of the central-cell region and partly to approximations involved in the present treatment that resulted in obtaining a lower limit for the size of the corrections. (auth)

36480 ON THE INFLUENCE OF A UNIFORM EXCHANGE FIELD ACTING ON THE SPINS OF THE CONDUCTION ELECTRONS IN A SUPERCONDUCTOR. G. Sarma (CEN, Saclay, France). Phys. Chem. Solids, 24: 1029-32(Aug. 1963). (In English)

The effect of a uniform exchange field acting on the spins of the conduction electrons is treated within the framework of the B.C.S. theory of superconductivity. The transition from the superconducting to the normal state is shown to be of the first or second order according to the values of the field. (auth)

36481 A COMMENT ON THE BORN MODEL TREATMENT OF THE POLYMORPHIC TRANSITIONS OF THE ALKALI HALIDES. Mario P. Tosi (Argonne National Lab., Ill.). Phys. Chem. Solids, 24: 1067-8(Aug. 1963). (In English)

Schumacher (Phys. Rev. 126: 1679 (1962)) calculated the transition pressure and volume change of the NaCl phase up to the transition for potassium chloride and rubidium iodide by assuming equal Born repulsive parameters for both the NaCl and CsCl structures. This assumption is shown to lead to a gross overestimate of the mechanical work in the transition and to a misrepresentation of the pressure-volume relationship of the CsCl phase. It is concluded that a proper Born-model treatment of polymorphic transitions in ionic crystals requires different repulsive parameters for the two crystals structures. (D.C.L.)

36482 MICROWAVE STUDIES OF ELECTRICALLY DRIVEN SHOCK WAVES. J. B. Gerardo, C. D. Hendricks, Jr., and L. Goldstein (Univ. of Illinois, Urbana). Phys. Fluids, 6: 1222-36(Sept. 1963).

The application of microwave interaction with gaseous plasmas to the study of electrically driven shock waves in

nonionized gases and gaseous plasmas is discussed. The microwave measurements are supplemented by observation of the visible light emitted from the shocked gas and by voltage-induced signals on small metallic probes placed in the path of the propagating shock waves. The investigated shock waves were in the Mach 4 to Mach 14 velocity range in neon and argon gases at pressures from 0.1 to 5mm Hg. The background gas through which the shock waves subsequently passes is ionized to a nonnegligible degree at the instant of the electric discharge by photons of adequate energy from the discharge chamber. It is also shown that at least in the particular shock tube used in this investigation, this preionization is consistent with ionization by soft x rays from the electron bombarded anode in the discharge chamber. The effect of the free electron constituent of the ionized background gas on the properties of the shock wave as well as its direct effect on some commonly used shock wave investigation techniques is discussed. (auth)

36483 COMMENT ON "STABILITY OF STEP SHOCKS." C. S. Gardner (Radio Corp. of America, Princeton, N. J.). Phys. Fluids, 6: 1366-7(Sept. 1963).

A shock breakup configuration is proposed as the exact nonlinear solution into which the unstable step shock will be deformed. It is pointed out that from a previous paper (NSA 17: 5127) a condition for the shock to be unstable against small ripples is also a condition for instability against breakup. (R.E.U.)

36484 REPLY TO COMMENTS BY C. S. GARDNER. Jerome J. Erpenbeck (Los Alamos Scientific Lab., N. Mex.). Phys. Fluids, 6: 1368(Sept. 1963).

A study in terms of the Hugoniot curve slope is made of the conditions under which small ripples in a plane shock front will grow exponentially with time. An extension to a paper that was previously abstracted for NSA (17: 5127). (R.E.U.)

36485 MULTIPHONON PROCESSES OCCURRING IN FIRST-ORDER PERTURBATION THEORY. E. G. Franzak and M. Bailyn (Northwestern Univ., Evanston, Ill.). Phys. Rev., 126: 2033-9(June 15, 1962). (SCR-537)

An estimate of the effect of the multiphonon processes in first-order perturbation theory on the electrical conductivity in metals is made, according to a simplified model of the electron-phonon interaction and a correspondingly simple model of the electron wave functions (plane waves). A method for taking Umklapp processes into account is worked in detail, and the calculation is set up in the framework of the variational principle. A sample computation of the effect of double-phonon processes on the conductivity of the alkali metals is performed using a nonisotropic phonon spectrum, the result being a decrease by less than four percent (1% being more characteristic for the lighter elements). The method is not restricted to long-wave phonons, but does not include the effects of higher-order perturbation theory or of interference terms, which may be considerable. (auth)

36486 PSEUDOSPIN MODEL FOR HARD-CORE BOSONS WITH ATTRACTIVE INTERACTION. ZERO TEMPERATURE. R. T. Whitlock and P. R. Zilsel (Western Reserve Univ., Cleveland). Phys. Rev., 131: 2409-20 (Sept. 15, 1963).

The many-body ground state and elementary excitations of the Matsubara-Matsuda cell model, which can be interpreted as a first approximation to Siegert's exact but untractable operator algebra for hard-core boson fields, are considered. The model has unphysical aspects, but allows treatment of some many-body effects of the interaction. It represents the hard core by restricting cell occupation numbers to ≤1, which changes the algebra from Bose to Pauli type; kinetic energy and attraction appear as interactions between nearest-neighbor cell pseudospins, equivalent to a Heisenberg ferromagnet with anisotropy in pseudospin space. This treatment, valid for scattering length $f_0 \geq 0$, splits the Hamiltonian into an isotropic unperturbed part H_0, describing a system with hard core plus attraction of strength making $f_0 = 0$, and AH_1, consisting of the attraction's deviation from this strength, the parameter $A \geq 0$ giving the magnitude of this (repulsive) deviation. The exact ground state of H_0, for any density, is the state symmetric in all pseudospins, with the appropriate eigenvalue of the total pseudospin component S^3 which measures N. These states exhibit what corresponds to incomplete Bose-Einstein condensation, the "excluded volume" effect of the hard-core constraint producing relative depletion ξ_0 of the condensate, proportional to ρ. Exact single excitations of H_0 are density fluctuations ρ_k with, however, free particle-like excitation spectrum, the ground-state energy being density-independent. Relaxing the restriction to eigenstates of N permits definition, by rotation of the total pseudospin from the vacuum, of a quasiparticle vacuum and operators, for any mean density. These serve as starting points for treating the full Hamiltonian by the equations-of-motion method in the random-phase approximation. The excitation spectrum is now phonon-like for small k, with $s \sim (\rho A)^{1/2}$. f_0 being expressible exactly in terms of A, E_0/N can be written in terms of f_0, ρ, and ξ_0, self-consistent in the RPA to order $f_0^{5/2}$. In the low-density limit, $\xi_0 \to 0$, there results the well-known expansion in (ρf_0^3), but there are higher density corrections including a term $\sim_0 f_0(\rho f_0^3)^{1/2} \xi_0^{3/2}$, due to the strong interaction included in the unperturbed many-body ground state. (auth)

36487 MAGNETOACOUSTIC EFFECTS IN LONGITUDINAL FIELDS. A. R. Mackintosh (Cambridge Univ., Eng. and Ames Lab., Ames, Iowa). Phys. Rev., 131: 2420-5 (Sept. 15, 1963).

The absorption of transverse and longitudinal ultrasonic waves was studied as a function of the magnetic field applied along the direction of propagation in pure tin and lead crystals at liquid-helium temperatures. At low fields, the attenuation of both transverse and longitudinal waves exhibits oscillations approximately periodic in reciprocal field, which are ascribed to electron orbits which execute a periodic motion along the field direction. The attenuation of transverse waves in tin shows regions of rapid decrease with magnetic field, which are interpreted as the absorption edges first predicted by Kjeldaas. In higher fields, the absorption of longitudinal waves appears to saturate at a nonzero value, while that of the transverse waves in tin appears generally still to be decreasing with field at fields of about 10 kG. (auth)

36488 ELECTROSTRICTIVE CONSTANTS OF INSULATING CRYSTALS. B. D. Silverman (Raytheon Co., Waltham, Mass.). Phys. Rev., 131: 2478-85(Sept. 15, 1963).

The electrostrictive constants of insulating crystals are related to the microscopic coupling parameters of lattice theory. This is done within the framework of the Born-Huang method of long waves. It is shown that the electrostrictive constants, as commonly defined, include the effects of Maxwell stresses and local stresses in the crystal. The connection between the theory and the properties of displacive ferroelectrics in the unpolarized phase is discussed. The relation between the observed temperature dependence of the electrostrictive coefficients and the tem-

perature dependent ferroelectric mode is exhibited. Order-of-magnitude agreement is obtained between the theory and experiment for $SrTiO_3$. (auth)

36489 FLUX CREEP IN HARD SUPERCONDUCTORS. Y. B. Kim, C. F. Hempstead, and A. R. Strnad (Bell Telephone Labs., Murray Hill, N. J.). Phys. Rev., 131: 2486-95(Sept. 15, 1963).

Resistive states of hard superconductors are investigated by tube magnetization and resistance measurements. The flux-creep theory of Anderson is very effective in accounting for the experimental observations reported herein. Resistive phenomena were observed in the presence of transport current density J and magnetic field B perpendicular to J. It is found that the whole spectrum of resistive states can be represented in terms of a single parameter $\alpha = J(B + B_0)$, where B_0 is a constant of the material. This parameter represents essentially the Lorentz force or the magnetic pressure gradient in the material. While a wide range of α values is possible, under given experimental conditions superconductivity usually cannot be maintained above a critical value. In tube magnetization, the critical value α_c is determined primarily by the rate with which the persistent current J decays. If α is raised beyond α_c, J decays rapidly and α quickly falls near to α_c. α continues to decrease slowly, but proportional to the logarithm of time as predicted by the theory. The observed temperature dependence of α_c is accounted for by the theory. Discrete, stochastic changes in field anticipated from the motion of flux bundles were detected through pickup coils placed in close proximity to the superconducting tube. In resistance measurements, voltages appearing across 3Nb-Zr wire samples were measured by supplying J externally in the presence of a perpendicular field H. The voltage observed is interpreted as a manifestation of an uncompensated emf arising from flux creep. At a given temperature, voltage readings obtained over a wide range of J and H are found to be a function of $\alpha = J(H + B_0)$ only. $V(\alpha,T)$ follows qualitatively a form expected from the theory. In resistance measurements, the critical value α_p is determined by the power dissipation in the material. If α is raised beyond α_p, thermal conduction lags the power dissipation and the sample undergoes a catastrophic transition to the normal state. (auth)

36490 SATELLITES IN THE MAGNETOPLASMA RESONANCE IN SODIUM. J. R. Merrill, M. T. Taylor, and J. M. Goodman (Cornell Univ., Ithaca, N. Y.). Phys. Rev., 131: 2499-2502(Sept. 15, 1963).

The low-frequency magnetoplasma resonance ("whistler" or "helicon") has been studied in rectangular parallelepiped samples of Na at 4°K using improved measuring techniques and higher magnetic fields in order to obtain greater resolution. Structure in the resonance was observed as satellites of the previously reported resonances. The observed frequencies of these satellites fit the simple formula reported earlier. (auth)

36491 EFFECT OF X-RAY INTENSITY ON THE PRODUCTION OF COLOR CENTERS IN NaCl AND KCl. Patrick G. Harrison (United Aircraft Research Labs., East Hartford, Conn.). Phys. Rev., 131: 2505-11(Sept. 15, 1963).

The results of a study of the effect of irradiation intensity on the coloration of NaCl and KCl are reported. Three observations stand out: (1) The equilibrium established between F and complex centers shifts to favor F centers with increasing intensity of irradiation. Cycling of the irradiation intensity between low and high values produces reversible shifts in the relative density of F and complex centers. (2) The density of F centers produced by uv irradiation of a crystal following optical bleaching of a prior x irradiation, increases with the intensity of the prior x irradiation. The density of uv-produced F centers could also be shifted in a reversible manner on cycling the intensity of x irradiation. (3) The intensity dependence of the F-center growth curves is present only at irradiation temperatures above 200°K. It is proposed that the intensity dependence of the F-center coloration arises from the establishment of a balance between two competing processes. It is proposed that the primary effect of x-ray photons is to disperse single vacancies in the crystal. Competing with this dispersal is the tendency of the anion vacancies to reaggregate by the diffusion of mobile vacancy units. (auth)

36492 MAGNETIC FIELD DEPENDENCE OF THE AMPLIFICATION OF SOUND BY CONDUCTION ELECTRONS. Harold N. Spector (Case Inst. of Tech., Cleveland). Phys. Rev., 131: 2512-19(Sept. 15, 1963).

A Boltzmann equation technique is used to calculate the magnetic field dependence of sound, amplified by interaction with conduction electrons in the presence of crossed d-c electric and magnetic fields. It is shown that both geometric resonances and cyclotron resonances can be found under conditions of amplification. This occurs when the electron-drift velocity in the crossed fields, v_H, has a component in the direction of propagation of sound which exceeds the sound velocity v_s. The geometric resonances occur under the same conditions as in zero electric field, but the cyclotron resonances are Doppler shifted and occur for $\omega - q \cdot v_H = n\omega_c$. (auth)

36493 VIBRATIONAL CORRECTIONS TO NUCLEAR MAGNETIC RESONANCE SECOND MOMENTS. D. E. O'Reilly and Tung Tsang (Argonne National Lab., Ill.). Phys. Rev., 131: 2522-3(Sept. 15, 1963).

The effect of rapid nuclear motions on the observable second moments of nuclear-magnetic resonance-absorption lines is considered by the method of lattice harmonics. An explicit formula is given in terms of time-averaged values of lattice harmonics. In the case of lattice vibrations in a cubic solid with a cubic point group at the nuclear site, the observable correction to the rigid lattice second moment is zero up to and including the second order in the relative nuclear amplitudes of vibration. In general, only the anisotropic vibrations contribute in second order to the observable second moment. (auth)

36494 EFFECT OF TEMPERATURE AND PRESSURE ON THE ELECTRICAL RESISTANCE OF FOUR ALKALINE EARTH METALS. R. A. Stager and H. G. Drickamer (Univ. of Illinois, Urbana). Phys. Rev., 131: 2524-7(Sept. 15, 1963).

The resistance of magnesium, calcium, strontium, and barium has been measured to 600 kbar at temperatures from 77 to 296°K. Magnesium shows some shallow maxima and minima in resistance along an isotherm, but no striking features. Calcium has a phase transition at about 150 kbar to a semimetallic phase, and a second transition initiating near 300 kbar, to a metallic state. Strontium has a sharp maximum in resistance below 40 kbar. Near the maximum it may be a semimetal. There is then a phase transition to metallic phase. Barium exhibits a very sharp rise in resistance at 140 kbar at 296°K (190 kbar at 197°K). At 77°K there is a transition at 240 kbar which is somewhat more sluggish. Isobars obtained on this high-pressure phase indicate a very sharp transition near 160°K. The evidence indicates that barium is a liquid at high pressure above 160°K. (auth)

36495 EVIDENCE FOR COVALENT BONDING FROM ELECTRON SPIN RESONANCE SPECTRA OF SOME RARE-EARTH IONS IN SINGLE CRYSTALS OF CALCIUM OXIDE. W. Low and R. S. Rubins (Hebrew Univ., Jerusalem). Phys. Rev., 131: 2527-8(Sept. 15, 1963).

Investigations of electron spin resonance (ESR) spectra of Yb^{3+} and Dy^{3+} in the cubic crystal field of calcium oxide show g factors which are smaller than the calculated g factors. It is shown that covalent bonding through the effect of the orbital reduction factor can explain these discrepancies. It is found that $(1 - k)$ is about 0.04, much smaller than found in the iron group, but larger than that found for rare earth ions in the crystal field of CaF_2. From the ESR spectra of Dy^{3+} and Er^{3+} it is inferred that the fourth-order potential B_4 is at least 200 times larger than the sixth-order potential B_6. (auth)

36496 BALMER EMISSIONS INDUCED BY H_2^+ AND H_3^+ IMPACT ON MOLECULAR HYDROGEN. L. L. Hatfield and R. H. Hughes (Univ. of Arkansas, Fayetteville). Phys. Rev., 131: 2556-8(Sept. 15, 1963).

Absolute cross sections for the production of H_α, H_β, and H_γ emissions by H_2^+ and H_3^+ impact on molecular hydrogen were measured for ion energies up to 130 kev. Emissions resulting from dissociative electron capture by the fast ion or from dissociative excitation of the fast ion are Doppler shifted from emissions resulting from dissociative excitation of the target gas, allowing separate measurements of these emissions. (auth)

36497 PROTON SCATTERING BY MOLECULES. I. THE TWO-STATE OXYGEN CASE AND THE MULTISTATE CASE. R. G. Breene, Jr. (Physical Studies, Inc., Centerville, Ohio). Phys. Rev., 131: 2560-5(Sept. 15, 1963).

The inelastic scattering of protons by oxygen molecules is treated for the collision situation resulting in the excitation of the upper state of the Schumann-Runge system. The incident proton energy ranges from 1 to 50 kev. The total cross sections and the growth coefficient phases for this scattering are computed using the two-state impact-parameter treatment. The distortion of the molecular charge cloud by the incident proton is taken into account in the phase calculation. A method for multistate impact parameter treatment of the inelastic collision is developed, and the equations therefor are derived. (auth)

36498 ANTISHIELDING OF MAGNETIC AND ELECTRIC HYPERFINE INTERACTIONS IN OPEN SHELL IONS. A. J. Freeman (Massachusetts Inst. of Tech., Cambridge and Army Materials Research Agency, Watertown, Mass.) and R. E. Watson. Phys. Rev., 131: 2566-73(Sept. 15, 1963).

In a previous paper (NSA 17: 25222), a method was presented for determining, within the framework of the unrestricted Hartree-Fock formalism, the contribution of closed atomic shells (called Sternheimer antishielding) to magnetic and electric hyperfine interactions. This method is applied to the study of the antishielding of both magnetic dipole and electric quadrupole interactions associated with the aspherical valence electrons of atoms and ions. In addition to closed shell antishielding, it is shown that there are repercussions within the open shell which are significant for hyperfine interactions. Results of specific computations for the free Fe^{2+} ion and the Cl atom are given, and comparisons are made with earlier perturbation theory results. An estimate is made of the quadrupole moment of the excited state of Fe^{57}. Finally, the serious symmetry problem, which is associated with polarization investigations applied either to atoms or solids, is discussed. (auth)

36499 ELECTRON DETACHMENT FROM 20-Mev D^- IONS BY A MAGNETIC FIELD. Selig N. Kaplan, George A. Paulikas, and Robert V. Pyle (Univ. of California, Berkeley). Phys. Rev., 131: 2574-7(Sept. 15, 1963).

The probability of electron detachment from 20-Mev D^- ions by the Lorentz force of a magnetic field is measured as a function of field strength. For a transit time through the magnetic field of $\approx 5 \times 10^{-10}$ sec, the detachment process becomes important at an equivalent electric field, $E = \gamma(v/c) \times B$, of about 3.2×10^6 v/cm and is essentially complete at 4.2×10^6 v/cm. The results are in agreement with calculations by Hiskes and Khoe. (auth)

36500 THE EINSTEIN GENERALIZED RIEMANNIAN GEOMETRY. Luther P. Eisenhart (Princeton Univ., N. J.). Proc. Natl. Acad. Sci. U. S., 50: 190-3(Aug. 15, 1963).

It is shown that the generalized Riemann tensor can be derived from Einstein's equations that relate the nonsymmetric covariant metric tensor of the space-time continuum of four dimensions and the contravariant tensor. (C.E.S.)

36501 MÖSSBAUER SPECTRUM OF IRON-57 IN IRON METAL AT VERY HIGH PRESSURES. M. Nicol and G. Jura (Univ. of California, Berkeley). Science, 141: 1035-8 (Sept. 13, 1963).

The effect of pressure on the Mössbauer spectrum of Fe^{57} in Fe metal has been studied as the pressure was increased presumably to more than 140 kbar. At pressures up to 120 kbar, a six-line spectrum characteristic of α-iron was observed. At 140 kbar, a seventh line appeared in the spectrum at -0.12 ± 0.06 mm/sec relative to stainless steel. This line was attributed to the appearance of the high-pressure phase of Fe. (auth)

36502 KINETIC EQUATION FOR NON-IDEAL FERMI GAS. I. B. Aleksandrov, Yu. A. Kukharenko, and A. V. Niukkanen. Vestn. Mosk. Univ., Ser. III, Fiz. Astron., No. 2, 15-24(Mar.-Apr. 1963). (In Russian)

A kinetic equation for a space-heterogeneous fermi ion system with non-local interaction potential was developed by means of perturbation theory. The equation was used to analyze a weakly heterogeneous system. Energy spectrum damping as a result of strong pairing correlations was indicated. (tr-auth)

36503 ANAMORPHOUS ELECTRON OPTICS. I. I. Tsukkerman. Zh. Tekhn. Fiz., 33: 505-11(May 1963). (In Russian)

Paraxial approximations were set up for electron-optical systems producing stigmatic images with enlargements in two mutually perpendicular directions. The developed systems were used for refining image transformations. A smaller one-direction enlargement can improve the resolving power of an instrument at the expense of the resolving power in the other direction. Singularities in the shape of electric and magnetic fields forming anamorphous electron lenses are discussed. (tr-auth)

36504 SPHERICAL ABERRATIONS OF QUADRUPOLE ELECTROSTATIC LENSES. A. M. Strashkevich (Kiev Polytechnic Inst.). Zh. Tekh. Fiz., 33: 512-17(May 1963). (In Russian)

Spherical aberrations of two quadrupole lenses (short and two-dimensional infinitely long) with double-symmetry and asymmetry were investigated. It was found that spherical aberrations in asymmetric systems can change the sign. (tr-auth)

36505 MOTION OF ELECTRONS IN SPACE-MODULATED MAGNETIC FIELD. V. G. Marinin (Inst. of Phys-

ics and Tech., Khar'kov). Zh. Tekhn. Fiz., 33: 518-21(May 1963). (In Russian)

An experimental study was made of the behavior of electrons in motion near the axis of a system in a static modulated magnetic field. Paramagnetic resonance of electrons, inducing a transformation of longitudinal electron energy into transverse motion, was analyzed, and it was found that the energy transformation along the axis is periodic in character. The results are in good agreement with theory. (tr-auth)

36506 ON CORPUSCULAR-OPTICAL PROPERTIES OF AXIALLY SYMMETRIC STATIC SYSTEMS WITH A ROTATING MAGNETIC FIELD. N. I. Shtepa (Orsk Pedagogical Inst., USSR). Zh. Tekhn. Fiz., 33: 522-9(May 1963). (In Russian)

Studies were made of the corpuscular-optical properties of axially-symmetric static fields with magnetic fields rotating around the axis of symmetry. Depending on the rate of magnetic field rotation, the system is either cumulative or scattering. The field rotation may compensate the axial symmetry charge in the pre-axial region. Rotating magnetic fields minimize and correct chromatic and third order aberrations and produce corpuscular optical lenses corrected along the spherical aberrations. The examined systems appear to have practical applications in equipment using ion beams. (tr-auth)

36507 GENERALIZED EXPRESSION FOR CURRENTS INDUCED BY CHARGED PARTICLE MOTION AND UNCHARGED CONDUCTORS. G. M. Gershtein (Saratov State Univ., USSR). Zh. Tekhn. Fiz., 33: 530-6(May 1963). (In Russian)

A generalized expression was developed for currents induced in a conductor system, considering the current induced by moving charges and by non-charged conductor motion in relation to other conductors and charges. Effects of field variations on the induced current were also considered. The generalized expressions were used for determining the current from charged particle motion in a condenser with vibrating plates and a condenser with a stationary electret between the plates. (tr-auth)

36508 LONGITUDINAL STABILITY OF A CHARGED PARTICLE BEAM CIRCULATING IN A MEDIUM. K. A. Barsukov and A. A. Kolomenskii (Lebedev Inst. of Physics, Moscow). Zh. Tekhn. Fiz., 33: 537-43(May 1963). (In Russian)

Longitudinal stability of a particle beam circulating in a medium with dielectric constant ϵ and magnetic penetrability μ was investigated. A dispersion equation was derived for longitudinal beam oscillations. (tr-auth)

36509 ON THE ELECTRON DISTRIBUTION RATE FUNCTION IN A POSITIVE COLUMN MERCURY DISCHARGE. N. A. Vorob'eva, Yu. M. Kagan, and V. M. Milenin (Leningrad State Univ.). Zh. Tekhn. Fiz., 33: 571-5(May 1963). (In Russian)

Measurements were made of electron energy distribution in a mercury positive column discharge as 10^{-4} to 10^{-1} mm Hg. At pressures $\geq 10^{-2}$ mm Hg the distribution function is close to Maxwellian for 0 to 4 ev. (tr-auth)

36510 MEASUREMENTS OF ION MOBILITY IN TRANSITIONAL UNIPOLAR CORONA FIELD. A. G. Lyapin (Krzhizhanovskii Inst. of Power Engineering, Moscow). Zh. Tekhn. Fiz., 33: 576-84(May 1963). (In Russian)

Theoretical relations for determining the mean value of ion mobility in a corona field were analyzed. A simple method was developed for numerically determining the motion, and an experimental verification of the method in the case a cylindrical ion capacitor with a range from one to ten milliseconds is presented. (tr-auth)

36511 STABILITY OF METAL VACUUM ARCS. [PART] I. I. G. Kesaev (All-Union Electrotechnical Inst., Moscow). Zh. Tekhn. Fiz., 33: 603-15(May 1963). (In Russian)

Vacuum arc stabilities for series of solid and liquid cathodes were investigated, and data are given on the mean duration of discharge at various currents, oscillation processes, and cathode spot structures in metals. (tr-auth)

36512 STABILITY OF METAL VACUUM ARCS. [PART] II. I. G. Kesaev (All-Union Electrotechnical Inst., Moscow). Zh. Tekhn. Fiz., 33: 616-24(May 1963). (In Russian)

An analysis was made of previously established regularities in quenching, oscillation and structural changes of cathode spots in metal vacuum arcs. (R.V.J.)

36513 CALCULATIONS OF AN ELECTRON OPTICAL SYSTEM WITH FOUR MAGNETIC SLITS. M. Siladi. Zh. Tekhn. Fiz., 33: 627-30(May 1963). (In Russian)

A theoretical analysis was made of a cylindrical magnetic lens consisting of four magnetic slits aligned parallel to the X axis. The distance between the slits along the Y axis is $2a = 7.5$ cm, and along the Z axis $2b = 5.0$ cm. The working field is not a function of the X coordinate, and the XZ plane is the field antisymmetry plane. Calculations were made of 24 trajectories for diverging and parallel beams with given values of nI (the number of coil ampere-loops) and ζ_0 (infinite coordinate). Diagrams are included for trajectories calculated for $\zeta_0 = 7.0$ and nI = 120, 110, and 100. (R.V.J.)

36514 EFFECTS OF ANISOTROPIC CONDUCTIVITY IN RAYLEIGH MAGNETOHYDRODYNAMIC PROBLEMS. E. G. Sakhnovskii (Ioffe Inst. of Physics and Tech., Leningrad). Zh. Tekh. Fiz., 33: 631-5(May 1963). (In Russian)

Laplace transformations are given for weakly ionized viscous flow in a semi-space, neglecting ion slip and compression. It was assumed that at $t = 0$ a flow was suddenly induced by a thin, impermeable, infinite-conductivity plane separating the gas region ($Z > 0$) from a static, solid conductor ($Z < 0$) and moving with a given velocity v(t) in a direction DY in the presence of a perpendicular heterogeneous magnetic field. (R.V.J.)

36515 DETERMINATION OF MAGNETIC FIELDS OF SPREADING CURRENTS. D. B. Gurevich and E. A. Svyadoshch (Leningrad Air Force Engineering Academy). Zh. Tekhn. Fiz., 33: 636-8(May 1963). (In Russian)

Magnetic fields of spreading currents (induced in conducting media by electric currents flowing from electrodes in the medium) were calculated. Expressions were developed for magnetic field components as series along the spherical coordinate axis. Moreover, the constant coefficients of the series were assumed to be equal to the reduction coefficient for spherical functions of spreading current potential. (R.V.J.)

36516 CONDITIONS UNDER WHICH A RELATIVISTIC CHARGED PARTICLE NEVER REACHES THE AXIS IN AXIALLY-SYMMETRIC FIELDS. N. I. Shtepa (Orsk Pedagogical Inst., USSR). Zh. Tekhn. Fiz., 33: 639-40(May 1963). (In Russian)

The relativistic static problem used for determining charged particle trajectories was reduced to nonrelativistic in order to determine conditions under which a relativistic particle moving in axially-symmetric constant electric and magnetic fields never reaches the axis. (R.V.J.)

36517 DIFFRACTION OF ELECTRO-MAGNETIC WAVES AT INCLINED INCIDENCE TO A PLANE METAL LATTICE WITH A DIELECTRIC LAYER. A. I. Adonina and V. P. Shestopalov (Khar'kov State Univ.). Zh. Tekhn. Fiz., 33: 641-51(June 1963). (In Russian)

The problem of electromagnetic wave diffraction was analyzed for inclined incidence on a metal lattice with a finite-thickness dielectric layer. The problem was resolved for arbitrary wave length-period and metal width-period ratios, dielectric thickness, and dielectric penetrability. Graphs were constructed for penetrability coefficients, diffraction spectra harmonics (the numerical data were machine computed), and equivalent boundary conditions. (tr-auth)

36518 DIRECTED SHOCK WAVES IN POWERFUL SPARKS. V. S. Komel'kov, Yu. V. Skvortsov, and V. N. Tereshchenko. Zh. Tekhn. Fiz., 33: 719-23(June 1963). (In Russian)

Electric discharge was investigated at atmospheric pressure and using currents up to 600 ka; the discharges taking place between annular and shaft electrodes. The examined system exhibited directed shock waves with velocities of 9×10^5 cm/sec. (R.V. J.)

36519 INVESTIGATIONS OF MAGNETIC FIELDS IN HYDROMAGNETIC SHOCK TUBES. Yu. V. Makarov and S. V. Nartov. Zh. Tekhn. Fiz., 33: 724-30(June 1963). (In Russian)

Magnetohydrodynamic shock tubes with conical chambers were investigated, and pictures were taken of shock wave excitations near annular electrode with and without external magnetic fields. Magnetic field capture during radial plasma compression into a conical chamber and axial transfer from the chamber into the tube was studied using tube windings and magnetic probes. (R.V.J.)

36520 OVERCHARGE AND IONIZATION IN NITROGEN ION COLLISIONS WITH HYDROGEN MOLECULES. I. P. Flaks and G. N. Ogurtsov (Ioffe Inst. of Physics and Tech., Leningrad). Zh. Tekhn. Fiz., 33: 748-53(June 1963). (In Russian)

Ionization and charge transfer cross sections were measured for single N^0, N^+, N^{2+}, and N^{3+} collsions with H_2 at 1 to 30 kw. At mean energy the curves for single electron transfer, $\sigma^{10}(T)$ and $\sigma^{21}(T)$, have a flat maximum and for N^{3+} ion the curve, $\sigma^{32}(T)$, rises steadily. Cross sections of single electron transfer depend very little on ion charge and achieve magnitudes of (6 to 7) $\times 10^{-16}$ cm^2. Cross sections for two-electron transfer, σ^{20} and σ^{31}, do not exceed 1.5×10^{-16} cm^2. Complete ionization cross sections for $N^+ - H_2$ and $N^{2+} - H_2$ pairs are identical, but are sharply increased for N^{3+} due to the considerable contribution of ionization-capture processes. (tr-auth)

36521 ON DETERMINATION OF ELLIPTIC LOOP MAGNETIC FIELD. L. A. Tseitlin. Zh. Tekhn. Fiz., 33: 758-9(June 1963). (In Russian)

Formulas were derived for determining elliptic-loop magnetic field configuration when the current within the symmetry plane passes through the large or small ellipse axis. (R.V.J.)

36522 ON THE DETERMINATION OF ELECTRIC AND MAGNETIC FIELDS OF THIN LAYERS AND ENVELOPES. L. A. Tseitlin. Zh. Tekhn. Fiz., 33: 760-2(June 1963). (In Russian)

Magnetic and electric fields of thin layers and shells were determined by a method that considers the thicknesses within the initial mathematical process. (R.V.J.)

36523 ANGULAR DISTRIBUTION OF SPUTTERED TUNGSTEN AND ZINC PARTICLES. V. A. Molchanov, V. Soshka, and M. A. Faruk. Zh. Tekhn. Fiz., 33: 766-8 (June 1963). (In Russian)

Angular distributions of tungsten and zinc particles from singly charged argon spallations at 30 kev were measured. Angular distribution half widths for zinc particles along the (101) axis were found near 24°. (R.V.J.)

36524 ON THE MOTION OF CHARGES ALONG THE AXIS OF A CHANNEL IN A MEDIUM. V. N. Tsytovich (Lebedev Inst. of Physics, Moscow). Zh. Tekhn. Fiz., 33: 795-800(July 1963). (In Russian)

A mathematical analysis was made of the electromagnetic mass of a particle in motion along a channel axis in an isotropic medium. Expressions were developed for various cases, including wide and very narrow channels. Conditions were found under which particle mass is a function of its energy, even at super-relativistic velocities. (tr-auth)

36525 THERMAL FLUX IN RELATIVISTIC MAGNETOHYDRODYNAMICS. G. M. Zaslavskii (Novosibirsk State Univ., USSR). Zh. Tekhn. Fiz., 33: 801-4(July 1963). (In Russian)

A kinetic expression of the viscosity tensor was previously found for charged particles in a magnetic field. The obtained kinetic equation was used for developing an expression for thermal flux in the presence of magnetic field and for determining coefficients of thermal conductivity. (R.V.J.)

36526 ALIGNMENT OF ELECTRON LONGITUDINAL VELOCITIES IN MODULATED FLUXES. A. T. Popov. Zh. Tekhn. Fiz., 33: 832-4(July 1963). (In Russian)

It is shown that in modulated dense fluxes it is impossible to achieve equilibrium electron longitudinal velocities in a space grouping. The design is given of an analyzer of electron longitudinal velocities. (R.V.J.)

36527 PROBLEMS ON THE THEORY OF A BOUNDARY LAYER IN CONDUCTING FLUID. K. E. Dzhaugashtin. Zh. Tekhn. Fiz., 33: 843-50(July 1963). (In Russian)

Magnetohydrodynamic equations for boundary layers were used to resolve various problems arising in field temperature and heat transfer calculations. Generalized forms of Stepanov's transformation were developed for conducting incompressible fluid and compressible gas flows in magnetic fields, with similar solutions for magnetohydrodynamic flow at boundary layers of rotating solids. (R.V.J.)

36528 QUADRUPOLE LENSES ANALOGOUS TO AN AXIALLY SYMMETRIC SYSTEM. A. D. Dymnikov and S. Ya. Yavor (Ioffe Inst. of Physics and Tech., Leningrad). Zh. Tekhn. Fiz., 33: 851-8(July 1963). (In Russian)

A system of quadrupole lenses analogous to axially symmetric systems and capable of reproducing a correct image of a subject placed at arbitrary distances is described. The system can operate as a collecting or scattering device. Charged particle trajectories developed for $l_1 = \pi/2$ and $l_2 = 3\pi/2[(d/b) = 4]$ are analyzed. (R.V.J.)

36529 EFFECTS OF AFTERGLOW ON ULTRA-SHORT LIGHT-FLASH DURATION IN SPARK DISCHARGE. S. I. Andreev and M. P. Vanyukov. Zh. Tekhn. Fiz., 33: 859-63 (July 1963). (In Russian)

Systematic studies were made of afterglow effects on light flash duration in nanosecond discharges in Ar, He, and N gases. The discharge circuit was placed in a quartz window chamber filled with gas to 25 atm pressure. The discharge current was recorded at 10^{-9} sec and discharge emission at 3×10^{-3} sec. The afterglow duration was determined as the difference between the light flash duration measured at $\frac{1}{3}$ maximum intensity and the total discharge current duration. (R.V.J.)

36530 ELECTRON CURRENT AT THE OUTLET OF A PENNING-TYPE TUBE. Yu. E. Kreindel. Zh. Tekhn. Fiz., 33: 883-5(July 1963). (In Russian)

Construction and performance of Penning cold-cathode tubes used as ion sources are described. An electrode distance of 40 mm, anode opening of 25 mm, and cathode input opening of 4 mm, with a Faraday cup for measuring the exit beam current, were used. Abnormally high energy electrons were observed with low cathode potentials. (R.V.J.)

36531 PROPAGATION OF SMALL TURBULENCES IN FINITE CONDUCTANCE GAS IN A MAGNETIC FIELD. K. A. Lur'e (Ioffe Inst. of Physics and Tech., Leningrad). Zh. Tekhn. Fiz., 33: 886-9(July 1963). (In Russian)

An attempt was made to prove that a concept of effective "speed of sound" in one-dimensional propagation of small turbulences in a gas with finite conductivity cannot be justified, either physically or mathematically. (R.V.J.)

36532 THEORY AND EXPERIMENT OF A CAPILLARY EMITTER IN A THERMIONIC CONVERTER. D. L. Dresser (General Motors Corp., Indianapolis), W. G. Laurita, J. D. Dunlop, H. Huber, and M. LeBihan. New York, American Inst. of Aeronautics and Astronautics, 1963, Preprint 63-156, 16p, $1.00. (CONF-97-16)

From Summer Meeting, Los Angeles, June 1963.

A capillary emitter concept in which a capillary structure is used as a dual source of electron emission and a dispenser of Cs ions is presented as a possible means of alleviating the close spacing requirement in thermionic converters. A random current theory is formulated in which the ion and electron currents are dependent upon the atom density at the capillary exit and the emitter temperature. The Cs flow equations are solved for the electrode geometry being studied to predict the exist pressure. The design and fabrication of two devices, a monocapillary structure and a multicapillary converter, are described. Experimental data from the multicapillary converter are compared with theory. It was found that the multicapillary converter is better than the ideal conventional converter at low Cs temperatures; at higher Cs temperatures a conventional device becomes better. In all cases where the multicapillary converter is superior, the absolute power density is too low for practical applications. (A.G.W.)

36533 PERFORMANCE OF LOW TEMPERATURE THERMIONIC CONVERTERS. Michael Silverberg and Lewis Haring (Ford Instrument Co., Long Island City, N. Y.). New York, American Inst. of Aeronautics and Astronautics, 1963, Preprint 63-159, 5p, $1.00. (CONF-97-11)

From Summer Meeting, Los Angeles, June 1963.

The low-temperature thermionic converter described employs an impregnated tungsten dispenser emitter, a low-voltage arc for space charge neutralization, emitter collector spacing of about 0.2" and a cesium reservoir temperature of about 200°C. A life test is continuing after almost 6,000 hr of operation. About 3 watts/cm^2 are being produced at a true temperature of 1250°C. (A.G.W.)

36534 THE CONE-AND-COLUMN: A NEW CONCEPT IN SOLAR ENERGY CONCENTRATION. Thomas J. McCusker (Goodyear Aircraft Corp., Akron, Ohio). New York, American Inst. of Aeronautics and Astronautics, 1963, Preprint 63-216, 7p, $1.00. (CONF-97-19)

From Summer Meeting, Los Angeles, June 1963.

The cone- and column-concentrator concept involves the principle of optical folding. When a suitable conical mirror is placed in front of a paraboloidal reflector, the image of the reflector can be made to lie near the reflector axis. The paraboloidal reflector then can be interchanged with its image. The new reflector (column reflector), combining with the conical mirror, will be the optical equivalent of the paraboloidal reflector. This concentrator is expected to make possible significant size and weight reduction in comparison with the equivalent paraboloidal dish. Thermal distortion problems are expected to be fewer than in other types of concentrators. The power loss due to the two additional reflections will be more than compensated for by the weight reduction. (A.G.W.)

36535 THERMIONIC EMISSION ENHANCEMENT FROM CESIUM COATED RHENIUM IN ELECTRIC FIELDS. J. G. de Steese and R. J. Zollweg (Westinghouse Research Labs., Pittsburgh). 9p. (CONF-68-2)

From Electrochemical Society, Pittsburgh, Apr. 1963.

The plasma-anode technique was used to observe anomalously high thermionic emission from a rhenium surface with small cesium coverage, where the work function of the composite surface is greater than the ionization potential of cesium. Data suggest that emission enhancement is caused by increased cesium coverage because of cesium-ion trapping near the emitter surface under the influence of an ion-rich sheath. (auth)

36536 MATERIALS REQUIREMENTS FOR THERMIONIC ENERGY CONVERSION. R. C. Allen and C. H. Skeen (Atomics International, Canoga Park, Calif.). 41p. (CONF-59-2)

From American Society for Metals, Western Metal Congress, Los Angeles, Mar. 1963.

The fundamentals of the thermionic energy conversion and its potential applications are reviewed. Materials problems associated with thermionic emitters are considered in relation to the following: work function; emissivity; vaporization; thermal, mechanical, and electrical properties; chemical stability; permeation; and stability under nuclear radiation. Cesium purity and materials suitable for collectors, electrical leads, support structures, insulators, and seals are also discussed. Experimental work on problems involved is reviewed. It is concluded that significant developments have occurred recently in all areas of thermionic energy conversion. (40 references) (A.G.W.)

36537 BOHR THEORY RADII OF THE ELEMENTS. C. J. O'Brien (Aerojet-General Corp., Sacramento, Calif.). 9p. (CONF-126-12)

From Conference on Noble Gas Compounds, Argonne, Ill., Apr. 1963.

Atomic radii of the elements are calculated using the Bohr radium equation for the hydrogen atom and assuming that the energy levels of an atom are determined by the energy levels of its hydrogen-like ion. The measured atomic radii for Li, Be, B, and C are from 0.09 to 0.02 Å less than the calculated radii. The average deviation of the calculated radii from the experimental radii for all elements is ±0.03 Å. (auth)

36538 LONG-LIVED EXCITED IONS IN COLLISION MASS SPECTROMETRY. J. William McGowan (Laval Univ., Quebec). 14p. (CONF-74-18)

From 11th Annual Conference on Mass Spectrometry and Allied Topics, San Francisco, May 1963.

It is important not only to measure collision cross sections involving ground state ions (and neutrals), it is equally important, and often more so, to determine the role that excited species play in the collision. It is the purpose of this review to summarize work on excited

ion-molecule collisions to: identify the long-lived excited ions present in the ion beam; measure the concentrations of excited ions in the excited beam; and measure the collision cross sections associated with these ions. (auth)

36539 INITIAL IONIZATION RATES IN SHOCK-HEATED ARGON, KRYPTON, AND XENON. Kenneth E. Harwell (California Inst. of Tech., Pasadena) and Robert G. Jahn. 27p. (Conf-46-96)

From American Physical Society 1963 Spring Meeting, Washington, D. C., Apr. 1963.

The rate of ionization behind strong shock waves in argon, krypton, and xenon is observed by a transverse microwave probe, over a range of electron densities low enough that atom-atom inelastic collisions are the rate-determining mechanism. Shocks of Mach number 7.0 to 10.0 propagate down a 2-inch-square aluminum shock tube into ambient gases at pressures of 3.0 to 17.0 mm/Hg, heating them abruptly to atomic temperatures of 5500 to 9600°K. The subsequent relaxation toward ionization equilibrium is examined in its early stages by the reflection, transmission, and phase shifts of a 24.0 Gc (1.25 cm) transverse microwave beam propagating between two rectangular horns abreast a glass test section. The data yield effective activation energies of 11.9 ± 0.5 ev for argon, 10.4 ± 0.5 ev for krypton, and 8.6 ± 0.5 ev for xenon. These coincide, within experimental error, with the first excitation potentials, rather than the ionization potentials of the gases, indicating that in this range ionization proceeds via a two-step process involving the first excited electronic states, of which the excitation step is rate-controlling. (auth)

36540 SOME PROBE EXPERIMENTS ON A HIGH ENERGY CESIUM ION BEAM. R. A. Hubach and G. B. Peppin (Hughes Research Labs., Malibu, Calif.). New York, American Institute of Aeronautics and Astronautics, 1963, Preprint 63021, 17p. (CONF-10-49)

From Electric Propulsion Conference, Colorado Springs, Colo., Mar. 1963.

A probe was developed, which is, in effect a directional Langmuir probe. The directional quality is necessary for use in a beam of high-energy ions to eliminate the effects of the streaming ions on the probe operation. This probe was utilized to measure the back-streaming (albedo) electron component to verify the bottle model of space-charge neutralization. It has also been prossible to infer the density of slow ions in the beam created by gas ionization and to infer a value of the cross section for such gas ionization which agrees with the anticipated value. (auth)

36541 AN INVESTIGATION OF A ONE KILOWATT HALL ACCELERATOR. H. E. Brandmaier, J. L. Durand, M. C. Gourdine, and A. Rubel (Curtiss-Wright Corp., Wood-Ridge, N. J.). New York, American Institute of Aeronautics and Astronautics, 1963, Preprint 63046, 33p. (CONF-10-54)

From Electric Propulsion Conference, Colorado Springs, Colo., Mar. 1963.

The steady state, one-dimensional, inviscid magnetogasdynamic (MGD) equations of flow are derived and applied to the analysis of a Hall-current accelerator. The effects of the thermodynamic and gasdynamic parameters are discussed, and various flow regimes are defined. From the results of a simplified analysis, which is shown to be a good approximation to the results of this paper, a Hall accelerator design was established by maximizing the efficiency with respect to the length required for MGD interaction. The C-W accelerator was designed to provide a thrust of 0.01 lb_f at a specific impulse of 2000 sec with 1 kw of input power. Preliminary tests with this device using slightly ionized argon demonstrated that axial thrust due to Hall forces was produced. (auth)

36542 STOPPING CROSS SECTIONS OF CARBON AND HYDROCARBON SOLIDS. C. A. Sautter and E. J. Zimmerman. 11p. (CONF-46-11)

From American Physical Society Meeting, Washington, D. C., Apr. 1963.

A Cockroft-Walton accelerator was used to study energy loss of low-energy protons and He^+ in passing through thin films of carbon and hydrocarbons. Polyvinyltoluene stopping cross sections for protons and He^+ from 40 to 350 kev, carbon stopping cross sections for protons and He^+ from 30 to 325 kev, and polypropylene stopping cross sections for protons from 160 to 300 kev are tabulated. (A.G.W.)

36543 TOTAL AND PARTIAL STOPPING POWERS OF HYDROGEN GAS FOR HELIUM PROJECTILES. 18p. (CONF-46-10)

From American Physical Society Meeting, Washington, D. C., Apr. 1963.

A helium beam was accelerated in a Cockcroft-Walton system and magnetic fields were used to select beams of He^0 and He^+. The stopping power of hydrogen molecular gas for the total He beam and the separated He^0 and He^+ beams was measured between 35 and 245 kev. Results are shown in curves and tables. It is calculated that about 40% of the total energy loss is due to charge changing events. (A.G.W.)

36544 IMPROVEMENTS RELATING TO ELECTRICAL DISCHARGE APPARATUS. Douglas Richard Chick (to Associated Electrical Industries, Ltd.). British Patent 931,912. July 24, 1963. Filed Mar. 4, 1959.

A toroidal container for gas discharge apparatus is patented. The liner of the container has many apertures or slots encircling the liner in rows. The slots are staggered to intercept direct current flowing parallel to the equator of the torus. The current is forced to flow in many zig-zag paths, but the resultant flow around the equator of the torus is negligible. This increases the resistance of the liner without producing undesirable currents around the equator. Several slot geometries are suggested. (M.P.G.)

Astrophysics, Cosmology, and Geophysics

36545 (AFCRL-62-350) FIELD-ALIGNED IONIZATION IRREGULARITIES. AN INVESTIGATION OF ECHOES OBSERVED FROM BRISBANE. Scientific Report No. 13. E. W. Dearden (Queensland, Australia. Univ., Brisbane). Mar. 1962. Contract AF64(500)-9. 86p. (AD-294723)

The areas of radio wave echo from ionospheric field-aligned ionization irregularities are studied, and explanations are proposed for various features of their behavior. Data on echoes are included, and relations to geomagnetic and ionospheric phenomena are considered. (D.C.W.)

36546 (AFCRL-62-353) ON OBSERVATIONS OF FIELD-ALIGNED IRREGULARITIES AND TRANSEQUATORIAL PROPAGATION. Final Report. Scientific Report No. 16. J. A. Thomas, E. W. Dearden, E. M. Matthew, R. W. E. McNicol, B. A. McInnes, D. G. Singleton, G. L. Goodwin, G. J. E. Lynch, and J. Crouchley (Queensland, Australia. Univ., Brisbane). Mar. 1962. Contract AF64(500)-9. 17p. (AD-294698)

The salient features of investigations at Brisbane on field-aligned irregularities and transequatorial radio propagation are summarized. (D.C.W.)

36547 (AFSWC-TDR-63-35) GEOCYCLOTRON FEASIBILITY STUDY. Final Report. T. F. Bell, R. A. Helliwell, R. F. Mlodnosky, and R. L. Smith (Stanford Univ., Calif. Radioscience Lab.). May 1963. Contract AF29(601)-4506. 152p. (AD-412948)

The results of an investigation on the feasibility of the geocyclotron experiment proposed by Helliwell & Bell are presented. The original suggestion that energy from a suitable VLF wave can be coupled to the trapped electrons is confirmed. It is found, however, that this coupling is restricted to certain conditions of the propagating wave. 47 references. (auth)

36548 (NASA-TR-R-169) SOLAR PROTON MANUAL. Frank B. McDonald, ed. (National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.). Sept. 1963. 120p.

The experimental knowledge on solar particle outbursts is summarized for the benefit of the spacecraft design engineer. A phenomenological description of solar particle events is presented, and time histories and tabulated data are given for the major events. The anisotropy of high energy solar cosmic rays observed in several events is also treated. 133 references. (auth)

36549 (NP-12622(Pt.5)) ELECTRICAL PROPERTIES OF THE EARTH'S CRUST. PART 5. ELECTRICAL PROPERTIES OF THE SEDIMENTARY COLUMN IN THE HIGH PLAINS. Progress Report. D. B. Jackson (Geological Survey, Denver). 1962. 18p.

Compilation of data on the electrical properties and anisotropy of sedimentary rocks using electric logs was begun in late 1961 in an area of about 75,000 square miles with corners at Denver, Colorado; Wheatland, Wyoming; Ida Grove, Iowa; and Troy, Kansas. Information was obtained on the geoelectrical section of sediments overlying the basement complex in the High Plains in order to interpret surface resistivity depth soundings. Results are presented in tables and graphs. (M.C.G.)

36550 THE SOFT X-RADIATION OF THE STARS. G. M. Nikol'skiĭ (Inst. of Terrestrial Magnetism, Ionosphere and Microwave Propagation, Academy of Sciences, USSR). Dokl. Akad. Nauk SSSR, 151: 536-8(July 21, 1963). (In Russian)

The first studies of the x radiation of the stars, undertaken during 1960 (E. B. Byram et al., Mem. Soc. Roy. Sci. Liège, 4: 469 (1961)) allowed only an estimation of the upper limits of the radiation. The work was continued, in an attempt to determine the anticipated radiation flux of the stars in the $\lambda < 100$ Å region. For most bright stars, there is a considerable amount of absorption by the interstellar H beyond the Lyman series; therefore only the extreme portions of the shortwave spectrum of the stars, lying in the $\lambda \gtrsim 1000$ Å and $\lambda \lesssim 100$ Å, can be observed. The "static" radiation of stationary stars, involving free electron transitions, photorecombination of the electrons with highly ionized atoms and excitation of the ions by electron collisions were considered; the latter process is considered as the most important one. The existence of the ions was determined by the electron temperature of the stellar corona. In the 20 to 100 Å range the calculations indicated that there are 10^{-3} quanta/cm^2 sec from the bright stars. The total x radiation from the galaxy was estimated at 10^{-12} to 10^{-10} erg/cm^2 sec by G. Clark; it was calculated that the total surface of the galactic disc is 5×10^{45} cm^2; the O–B class stars radiate about 10^{29} erg/sec in the $\lambda < 40$ Å range. This yields a flux of 3×10^{-10} erg/cm^2 sec or about 3 quanta/cm^2 sec. In the $\lambda < 8$ Å the radiation must be considerably lower. (TTT)

36551 A GENERALIZATION OF FRIEDMAN'S MODEL OF THE UNIVERSE. K. P. Stanyukovich (Scientific Research Inst. of Electromechanics, USSR). Dokl. Akad. Nauk SSSR, 151: 546-9(July 21, 1963). (In Russian)

In view of interest in the possible change of the so-called "gravitational constant" with time, Friedman's model of the Universe was extended to this case. In the classical Friedman models the rate of the expansion of the Universe is constant; however, the motion of the "boundary" should be equal to the expansion of the first particle with a rest mass of zero, which in turn is equal to the speed of light and therefore should be constant. The rate of expansion can reach a constant value only if a supplementary tensor of a hypothetical field is introduced in Friedman's model. Such tensors were used in the mathematical derivation: they included the energy-pulse tensors of the medium, consisting of particles with rest masses of zero and differing from zero, and a pseudotensor defining the zero rest-mass particles. These tensors must be introduced in the equations because the energies of the various fields and the neutrino are commensurable with the energy of the particles having a rest mass other than zero. The mathematical derivation is given. (TTT)

36552 ALTITUDE DISTRIBUTION OF CHARGED PARTICLES IN THE IONOSPHERE AND THE TRANSITION ZONE BETWEEN THE OXYGEN AND THE HELIUM ION LAYERS DETERMINED BY THE ION-TRAP EXPERIMENTS OF THE "COSMOS-2" SATELLITE. K. I. Gringauz, B. N. Gorozhankin, N. M. Shyutte, and G. L. Gdalevich. Dokl. Akad. Nauk SSSR, 151: 560-3(July 21, 1963). (In Russian)

The previous studies carried out during the IGY on the distribution of charged particles in the upper ionosphere as a function of the altitude were continued with the satellite Cosmos-2, launched on April 6, 1962. This latter study indicated that the previous findings prevail only during periods close to the maximum of solar activity and thus change with time. The satellite, which had a perigee and an apogee of about 212 and 1546 km, respectively, carried experimental devices, such as 8 three-electrode ion traps placed on the external surface and special spherical ion traps. The data yielded by these instruments indicated that the transition zone between the O^+ and the He^+ ion layers was located at a much lower altitude than found during the 1958-1960 tests. Magnetic perturbation of similar order of magnitude occurred at the time of flight of the third Sputnik and during the tests with Cosmos-2, therefore the differences in the structure of the ionosphere cannot be attributed to magnetic effects. The data agree with the calculations of J. Harris and W. Priester (J. Geophys. Res., 67: 4585 (1962)) who correlated the changes in the altitude distribution of the molecular weight of neutral particles with the solar activity. (TTT)

36553 GEOCHEMICAL STUDY OF BORON ISOTOPES. Makoto Shima (Univ. of California, San Diego). Geochim. Cosmochim. Acta. 27: 911-13(Aug. 1963).

There is not a general agreement concerning the isotopic abundance ratio B^{11}/B^{10} of boron in natural minerals. The B^{11}/B^{10} ratios of rocks and sea water which are typical of terrestrial samples are around 4.05 ± 0.05. The B^{11}/B^{10} ratios in meteorites are lower than the terrestrial value. (auth)

36554 RESULTS OF RECENT DECAMETER-WAVELENGTH OBSERVATIONS OF JUPITER. Alex G.

Smith, T. D. Carr, and N. F. Six (Univ. of Florida, Gainesville and Universidad, Santiago, Chile). Mem. Soc. Roy. Sci. Liege (5), 7: 543-50(1963). (In English)

The number and zenographic distribution of the decameter radio sources on or about the planet Jupiter are investigated to determine the possible energy sources and conversion mechanisms. The smoothed probability profile for Jovian sources at 18 Mc is presented. The apparent inverse correlation between sunspot numbers and the general activity of Jupiter in the decameter region is discussed. The effect of Jupiter's orbital inclination with respect to the solar axis of rotation is also considered. Spectra of short and normal pulses are compared. (C.E.S.)

36555 ON THE HAYASHI EFFECT IN THE EARLY PHASES OF GRAVITATIONAL CONTRACTION OF THE SUN. J. Faulkner, K. Griffiths, and F. Hoyle (Cambridge Univ., Eng.). Monthly Notices Roy. Astron. Soc., 126: 1-10 (1963).

Computations are made using a program for the subphotospheric layers, including opacity effects due to the negative hydrogen ion and to Rayleigh scattering. Under thermodynamic conditions completely convective models are found to occur, displaced toward late types in the H-R (Hertzsprang-Russell) diagram. The models investigated range from the late K subclasses to about M_3. Nonthermodynamic effects are considered. It appears that free electrons produced by high-energy particles are capable of modifying the results by reducing the effective temperature and luminosity, but not by completely removing the convective structure. Nor does it seem likely that opacity effects arising from solid particles can destroy the convective structure. The possibility remains, however, that convective efficiency in the subphotospheric layers could be much reduced by a magnetic field at the stage where the planetary material separated from the Sun, and during the condensation of the first planetesimals and of the parent bodies of the meteorites. Only by a suppression of the high-luminosity convective models during this phase does it seem possible to explain the presence of water in meteorites, and the likely presence of any icy matrix in the first planetesimals. (auth)

36556 INTERPLANETARY MAGNETIC FIELDS AS A CAUSE OF COMET TAILS. David B. Beard and M. Paul Nakada (Goddard Space Flight Center, Greenbelt, Md.). Nature, 199: 580-1(Aug. 10, 1963).

Satellite measurements have established that the solar wind consists of plasma the protons of which have an isotropic thermal energy of a few electron volts and a kinetic energy due to their stream velocity of a kilovolt or so. These findings are the basis for the conclusion that the gases in cometary comas will be efficiently ionized by the solar wind of ionized hydrogen embedded in a magnetic field, that an interplanetary magnetic field will couple the cometary gas to the solar wind, and fluctuations in solar wind pressure will create accelerations in comet tails. (C.H.)

36557 ON THE PHILOSOPHICAL INTERPRETATION OF THE ELEMENTARY SYNTHETIC AND DECAY PROCESSES IN THE UNIVERSE. Gerhard Poppei (Humboldt Universität, Berlin). Wiss. Z. Humboldt-Univ. Berlin, Math. Naturw. Reihe, 11: 233-41(1962). (In German)

After a brief discussion of nuclear reactions of heavy elements it is concluded that the synthesis of elements in stars involves both conflict and unity of antagonistic forces. The study of this process shows that the philosophic concepts of necessity and chance, quality and quantity, continuity and discontinuity, rest and motion, particular and general, correspond to respective concepts in individual sciences. In the elementary form of motion, nuclear synthesis is antagonistic to radioactive decay. (BBB)

36558 PHILOSOPHICAL CONSIDERATIONS OF THE SYNTHESIS OF HEAVY ELEMENTS. G. Poppei (Humboldt Universität, Berlin). Wiss. Z. Tech. Hochsch. Otto von Guericke Magdeburg, 6: 337-9(Jan. 1963). (In German)

Cosmic aspects of nuclear reactions are reviewed. According to modern theory synthesis of heavy elements in supernovae is related to several sudden discontinuous movements in stellar development. Gravitational collapse and stellar explosion, cooling down and heating up, nuclear dissipation and nucleosynthesis are antagonistic factors, the influence of which upon linked stellar and nuclear development in supernovae is discussed. (BBB)

36559 A BRIEF DISCUSSION OF THE RADIATION AND METEOROID ENVIRONMENT IN SPACE. C. E. Melton. 51p. (CONF-14-37)

From American Chemical Society 144th National Meeting, Los Angeles, Mar. 1963.

The galactic cosmic ray flux is expected to be about 2.5 particles/cm^2 sec, resulting in a dose of about 5 rad/year (through 1 gm/cm^2 Al), and should not present a formidable hazard for spacecraft. The dose rate within the most intense region of the inner zone is expected to be about 15 to 20 rad/hr. For the intense region of the outer zone, the dose rate is expected to be on the order of 2 to 6 rad/hr. The estimated dose rate inside the Mercury capsule from a nuclear bomb burst should be on the order of 1 rad per 6-orbit mission. For a reasonably fast traversal of the trapped radiation zones (that is, about 1 hour for passage through inner zone) no immediate hazard is apparent. The least predictable radiation hazard for a spacecraft is the radiation dose resulting from solar cosmic ray events. The integrated dose from the solar events may range from a negligible amount to several thousand rad. Based on preselected criteria, it is shown that the resultant dose for some events could effect spacecraft components. The meteoroid population in space is evaluated in terms of earth-based measurements as well as results obtained from artificial earth satellites. Chosen flux distributions and Bjork's penetration equation are used to estimate necessary armor shielding for a given mission. (auth)

Cosmic Radiation

Refer also to abstract 35332.

36560 (AD-293911) INVESTIGATION ON THE PRIMARY COSMIC RADIATION. Status Report No. 2 (Final), June 16, 1961–June 15, 1962. M. W. Friedlander (Washington Univ., St. Louis). Contract AF49(638)-833. 3p.

Experimental procedures used to investigate fragmentation parameters for heavy nuclei in air, the flux of heavy primaries, geomagnetic effects on cosmic radiation, and the energy spectrum of alpha particles are briefly described. (D.C.W.)

36561 (UAG-R-127(Pt.I)) INTERPRETATIONS OF THE TIME VARIATIONS OF POLAR CAP ABSORPTION ASSOCIATED WITH SOLAR COSMIC RAY BOMBARDMENTS. Scientific Report No. 3. H. Leinbach (Alaska. Univ., College. Geophysical Inst.). May 1962. 123p. (AD-289789)

Theory on the relation between solar cosmic radiation and polar cap absorption (PCA) is reviewed, particularly ion pair production in the atmosphere and its relation to the equilibrium electron density distribution. The magneto-

ionic theory on the relation between electron density and radio wave absorption is also outlined. The cosmic noise technique for studying radio wave absorption is described, and 20 outstanding PCA events observed by riometers since 1957 are discussed. (D.C.W.)

36562 (UAG-R-127(Pt.II)) INTERPRETATIONS OF THE TIME VARIATIONS OF POLAR CAP ABSORPTION ASSOCIATED WITH SOLAR COSMIC RAY BOMBARDMENTS. Scientific Report No. 3. H. Leinbach (Alaska. Univ., College. Geophysical Inst.). May 1962. 230p. (AD-290136)

The essential theory having been outlined in Part I, time variations of high latitude absorption are interpreted in terms of the extraterrestrial variations of particle flux. Classification of polar cap absorption (PCA) events into two categories on the basis of the relation of the absorption magnitude to the onset of the associated magnetic storm is also proposed. The properties of the two categories strengthen the hypothesis of storage of energetic solar cosmic rays in the corpuscular stream. Additionally, some lower latitude features of PCA events, such as the midday recovery of absorption, the recovery observed during the initial phase of the magnetic storm, and the southward expansion of the polar cap region during the main phase of the magnetic storms, are interpreted in terms of the geomagnetic field's influence on the solar particles. 96 references. (D.C.W.)

36563 PRODUCTION OF π MESONS AND GAMMA RADIATION IN THE GALAXY BY COSMIC RAYS. J. B. Pollack (Harvard Univ., Cambridge, Mass.) and G. G. Fazio. Phys. Rev., 131: 2684-91(Sept. 15, 1963).

A detailed analysis is presented of the most probable sources in our galaxy of gamma radiation with energy greater than 0.2 Mev. Predictions are made of the resulting fluxes and their angular distribution in the vicinity of the earth. The results of these calculations and their implications for future gamma-ray experiments and detectors are discussed. (auth)

36564 NUCLEI OF THE PRIMARY COSMIC RADIATION WITH $Z \geq 2$ AT HIGH LATITUDES. M. Koshiba (Univ. of Chicago), E. Lohrmann, H. Aizu, and E. Tamai. Phys. Rev., 131: 2692-8(Sept. 15, 1963).

A large stack of nuclear emulsions was flown on 4 September 1959, near Sioux Falls, South Dakota, at an altitude of more than 135,000 ft. The stack was flipped at altitude. Stringent scanning criteria were applied. This allowed a determination of the Li Be B flux with very small uncertainties. 971 nuclei with $Z \geq 3$ were identified. The ratio L/M nuclei is 0.51 ± 0.07 at 200 Mev/N $< E <$ 700 Mev/N and 0.32 ± 0.03 at energies >700 Mev/N. This substantial increase of light nuclei with decreasing energy is found for all light nuclei Li, Be, and B. It is concluded that the amount of material traversed by the cosmic radiation before reaching the earth is larger for the slower particles. For the rest of the elements with $Z < 10$ the abundances do not change at low energies <700 Mev/N within statistics compared to results at high energies. Very little F is found at both high and low energies. C is found to be the most frequent element also below 700 Mev/N. Further results given are absolute flux values, the energy spectrum of light, medium, and heavy nuclei from 100 to 700 Mev/N and of α particles from 100 to 300 Mev/N. A cutoff energy of about 150 Mev/N is found for heavy primaries, much lower than the value calculated by Quenby and Wenk. (auth)

36565 ENERGETIC PARTICLES IN THE MAGNETOSPHERE. John R. Winckler and Roger L. Arnoldy (Univ. of Minnesota, Minneapolis). 35p. (CONF-83-1)

From International URSI Conference, Tokyo, Sept. 1963.

The energetic particles above approximately 5 kv in the Van Allen radiation regions are known to consist almost entirely of protons and electrons. The best current information about these particles is summarized. Selected data are presented. Possible sources of the particles are discussed. (44 references) (A.G.W.)

Elementary Particles and Radiations

36566 (AD-295975) RESEARCH IN HIGH ENERGY PHYSICS AND RELATED TOPICS. Final Report, October 1961–October 1962. J. Hamilton (London. Univ. University Coll.). Nov. 27, 1962. 5p.

Dispersion relation techniques were used to analyze π-N scattering, and the proton spectrum and electron-proton distribution for hyperon(Λ) leptonic decay were derived. The analyses gave (with agreement) information on the interactions of incident pions with nuclear pions as well as on the causes of p-wave π-N scattering. (D.C.W.)

36567 (BNL-6406) REMARKS ON THE DOUBLE DISPERSION APPROACH TO THE BETHE-SALPETER EQUATION. Noboru Nakanishi (Brookhaven National Lab., Upton, N. Y.). Aug. 7, 1963. Contract AT-30-2-GEN-16. 17p.

The limits of applicability of the double dispersion approach previously used to obtain invariant solutions of the Bethe-Salpeter equation for bound states of two scalar particles are investigated. (D.C.W.)

36568 (BNL-6569) INELASTIC INTERACTIONS OF 11.4 Bev/c π^- MESONS IN HYDROGEN. T. Ferbel and H. Taft (Yale Univ., New Haven and Brookhaven National Lab., Upton, N. Y.). [nd]. Contract [AT(30-2)-gen-16]. 29p.

Production cross sections and angular distributions of Λ and K^0 particles produced by 11.4 Bev/c π^- mesons in hydrogen were measured. A systematic investigation was made of all two-body decays of unstable neutral particles. No events inconsistent with γ, Λ, or K^0 were found. Production cross sections, angular distributions and effective mass distributions of π mesons produced in 4-prong events were also measured. No evidence for dominance of any high mass multi-pion resonance was found. Both the pion production and strange particle production reactions demonstrated peripheral characteristics in that the baryon was strongly peaked backward in the center of mass. The average transverse momentum was observed to be a monotonically increasing function of mass. The experimental total interaction cross section was 25.3 ± 1.5 mb. The effect of the pion-nucleon $T = 3/2$ isobar was clearly observed. (auth)

36569 (CONF-122-8) EXPERIMENTAL PREDICTIONS FROM UNITARY SYMMETRY (SU_3). C. A. Levinson (Weizmann Inst. of Science, Rehovoth, Israel); H. J. Lipkin (Illinois. Univ., Urbana and Argonne National Lab., Ill.); and S. Meshkov (National Bureau of Standards, Washington, D. C.). [1963]. Contract [W-31-109-eng-38]. 5p.

From International Conference on Nucleon Structure, Stanford, Calif., June 1963.

Some relations arising from U-spin conservation for photoproduction; electromagnetic decays of N^*, Y^*, and Ξ^*; production of Z^{-}, Ξ^{*-}, Y_1^{*-}, N^{*-}, and vector mesons; and the $K\text{-}\overline{K}$ and $\Sigma^+ - p$ systems are presented. (D.C.W.)

36570 (CONF-122-9) ON PSEUDOSCALAR CHARGE DENSITY. K. Hiida (Argonne National Lab., Ill.). June 21, 1963. Contract [W-31-109-eng-38]. 2p. (UAC-7745).

From International Conference on Nucleon Structure Stanford, Calif., June 1963.

Parity-nonconserving interactions are examined to show that the charge density of the nucleon consists of both scalar and pseudoscalar parts and that these charge densities have the same form factor. The physical reality of the pseudoscalar charge is demonstrated. (D.C.W.)

36571 (EFINS-62-61) PION-NUCLEON INTERACTIONS IN THE INTERMEDIATE ENERGY RANGE. Richard C. Arnold (Chicago Univ. Enrico Fermi Inst. for Nuclear Studies and Chicago. Univ.). Nov. 1962. Contract AT(11-1)-264. 60p.

A detailed dynamical calculation is carried out to try to understand the formation of the resonances in elastic π-N scattering. The method used is a subtracted form of a two-channel N/D method, using Born terms for the dynamical cuts arising from ρ^- exchange, 3-3 crossing, and crossed nucleon terms. The pion production at intermediate energies (below 1500 Mev) is represented by the formation of a ρ with the one-pion exchange process, and the two-channel processes are required to satisfy unitarity approximately. It is found that the pattern of higher resonances is essentially determined by the elastic amplitude dynamical cuts, in particular the 3-3 crossing term, but the inelastic process has a strong reactive damping effect which may determine the resonance widths. A vector meson model of strong interactions is used to estimate the π-π-ρ, ρ-N-N, and ρ-ρ-ρ vertex strengths. (auth)

36572 (JINR-D-1329) SMALL-ANGLE ELASTIC PROTON-PROTON SCATTERING AT 6 AND 10 Gev. L. F. Kirillova, V. A. Nikitin, A. A. Nomofilov, V. A. Sviridov, L. N. Strunov, and M. G. Shafranova (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of High Energy). 1963. 8p.

The relative behavior of the differential elastic p-p scattering cross section has been obtained for the proton energies of 6 and 10 Bev in the range of momentum transfers where the Coulomb scattering is essential ($0.003\ \text{Bev}^2/c^2 < t < 0.08\ \text{Bev}^2/c^2$). 22,000 events of elastic scattering have been detected. It was found that the value of the differential cross section at small t is larger than that calculated by the optical theorem. Two possibilities of accounting for this effect are treated: either there exists the real part in the scattering amplitude, or the singlet and the triplet scattering amplitudes are different. This experiment is in better agreement with the assumption that the real part of the scattering amplitude in the first case or the scattering amplitude in the singlet state in the second case have a narrower angular distribution than the imaginary part of the scattering amplitude. (auth)

36573 (JINR-E-1271) ON A CONNECTION BETWEEN THE TOTAL CROSS SECTIONS OF REACTIONS $\frac{1}{2} + \frac{1}{2} \rightarrow 0 + 0$ AND THE INTRINSIC PARITIES OF PARTICLES. S. M. Bilenkii (Bilenky) and R. M. Ryndin (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1963. 7p.

Reactions of the type $\frac{1}{2} + \frac{1}{2} \rightarrow 0 + 0$ are considered, $\frac{1}{2}$ and 0 being the particle spins. It is shown that the coefficient of $\vec{P}_0\vec{P}$ in the expression for the total cross section of the reaction with polarized particles ($\vec{P}_0$ and $\vec{P}$ being the polarizations of the beam and the target) is positive if the product of the intrinsic parities is -1; it is negative otherwise. This property of the total cross sections can be used to determine the parities of strange particles. (auth)

36574 (JINR-E-1298) QUASIOPTICAL METHOD AND ASYMPTOTIC BEHAVIOUR OF MANY CHANNEL AMPLITUDES. A. A. Logunov, Nguyen Van Hieu, and O. A. Khrustalev (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1963. 13p.

Making use of Lippman-Schwinger equations with local complex potentials, the asymptotic behavior of many channel amplitudes are investigated. It has been shown that in the case of potentials without the subtraction the amplitudes have a Regge behavior with the same trajectory. The role of subtraction terms that may lead to the non-Regge-type behavior is considered. (auth)

36575 (JINR-E-1339) p-p PHASE SHIFTS AT 660 Mev. L. S. Azhgirei, N. P. Klepikov, Yu. P. Kumekin, M. G. Mescheryakov, S. B. Nurushev, and G. D. Stoletov (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Nuclear Problems). 1963. 10p.

The results of a phase shift analysis on p-p scattering are presented. The data used in the analysis are included as well as the phase shifts, mixing parameters, and absorption coefficients derived. The real parts of the phase shifts can be connected by smooth curves with the corresponding phase shifts that have been found at lower energies. (D.C.W.)

36576 (JINR-P-1295) O DIAGRAMMAKH NA MASSOVOI POVERKHNOSTI. (On Diagrams of Mass Surfaces). G. I. Kopylov (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of High Energy). 1963. 12p.

A function on the mass shell constructed by the Cutkosky method is considered for the ladder diagram. It is shown that it may be represented as a multiple integral of the real function over the real region. (auth)

36577 (JINR-P-1300) ELECTROMAGNITNYE RASPADY η-CHASTITSY. (Electromagnetic Decays of η-Particles). V. G. Grishin and M. I. Podgoretskii (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of High Energy). 1963. 14p.

Decay properties of a meson(η) are treated. It is pointed out that this problem is connected with a check of the isotopic invariance in strong interactions. (auth)

36578 (PIBMRI-1064-62) LEAKY WAVES IN ELECTROMAGNETIC PHENOMENA. Arthur A. Oliner (Brooklyn. Polytechnic Inst. Microwave Research Inst.). Aug. 2, 1962. Contract AF19(604)-7499. 37p. (AD-294831; AFCRL-62-908)

The properties of leaky waves (waves that can be supported by an interface) are discussed, and their usefulness is illustrated in connection with so-called leaky wave antennas, radiation from source-excited plasma layers, radiation from periodically-modulated surfaces, log-periodic antennas, Wood's anomalies on periodic structures, and Cherenkov and Smith-Purcell radiation. 25 references. (auth)

36579 (TID-17868) RELATION BETWEEN LEE-MODEL AND POTENTIAL-MODEL SCATTERING WHEN SEVERAL BOUND STATES ARE POSSIBLE. Alvin M. Saperstein (Argonne National Lab., Ill.). Nov. 1962. Contract W-31-109-eng-38. 5p. (UAC-7033)

The assumption of equivalence between calculations based on a nuclear optical-model potential and calculations based on the Lee model in the limit as the bound-state wave-function renormalization constant goes to zero is tested for a potential in which several bound states are possible. It is shown that although the correspondence between the Lee and potential models can easily be extended to several bound states, it breaks down for scattering states because of interference between the contributions to the scattering from the different bound states in the potential model. (D.C.W.)

36580 (TID-17979) MUTUAL COUPLING BETWEEN Σ,Λ NON-LEPTONIC DECAY VERTICES AND TWO-POINT HYPERON NUCLEON VERTICES; THEIR LIFETIME AND ASYMMETRICAL PROPERTIES OF DECAY. Mao-Chao Chen (Massachusetts Inst. of Tech., Cambridge. Lab. for Nuclear Science and Massachusetts Inst. of Tech., Cambridge). 1962. Contract AT(30-1)-2098. 32p.

It is shown that the hyperon-nucleon two-point vertices cannot be renormalized to zero in second order perturbation diagrams. These vertices are treated mutually coupled with the non-leptonic decay vertices of Λ and Σ hyperons. A set of coupled equations among these vertices is derived within the frame of perturbation theory by assuming the relative parities of Σ−Λ even, and Λ−N−K and Σ−N−K odd. They are solved with the approximation of global symmetry and baryon mass degeneration whenever the latter would not cause difficulty. The solutions contain only two undetermined parameters, a proportionality constant and the product of the K−π vertex and the Λ−N−K (or Σ−N−K) coupling constant. These two parameters determine completely all non-leptonic decay properties, and will be chosen to fit experiments. A cut-off parameter turns out too low. But the calculated decay parameters generally agree with experiments. Whether the difficulty with the low cut-off originates from the model itself or from not using the actual strong coupling constants and parities is not known. (auth)

36581 (TID-19331) PRODUCTION AND SCATTERING IN SIMPLE MODELS. H. Chew (Columbia Univ., New York). [nd]. Contract AT(30-1)-1808. 23p.

Some properties of the Vθ scattering amplitude in the Lee model are derived and discussed with reference to the influence of production (Nθθ) on scattering. It is shown that as long as the coupling is not too weak, production has important effects on scattering even at low energies. For a wide class of well-behaved cutoff functions there can be no resonance in Vθ scattering unless production is taken into account. Static model calculations for meson−baryon scattering neglecting production can therefore be quite misleading. There is in general no close relation between the locations of resonances in Vθ scattering and the production threshold, even in the strong coupling limit $Z \approx 0$. A modified version of the Lee model with odd NVθ parity is discussed. Two different sets of integral equations for the Vθ → Vθ and Vθ → Nθθ amplitudes are derived, in which the influence of spin enters in a non-trivial way. (auth)

36582 (TID-19336) EXCITED STATES OF THE NUCLEON. P. Carruthers (Cornell Univ., Ithaca, N. Y. Lab. of Nuclear Studies and Cornell Univ., Ithaca, N. Y. Lab. of Atomic and Solid State Physics). July 1963. Contract AT(30-1)-2391. 93p.

The quantum numbers of the higher resonances in π-N scattering belonging to the nucleon and 3-3 isobar trajectories are shown to arise from the exchange of the nucleon and π-N resonances themselves. In particular, the members of the nucleon trajectory are created principally by forces due to the exchange of members of the 3-3 isobar trajectory and vice-versa. The quantum numbers obtained from dynamical considerations agree completely with these conjectured on the basis of Regge pole considerations. The dynamical scheme is approximately symmetrical under interchange of the two trajectories. 52 references. (auth)

36583 (TID-19342) PRODUCTION OF STRANGE PARTICLES BY $\pi^+ - p$ COLLISIONS AT 2.08 Gev/c. Horst W. J. Foelsche and Henry L. Kraybill (Yale Univ., New Haven). [1963]. Contract [AT(30-1)-1349]. 20p.

The total cross section for strange particle production by 2.08-Bev/c π^+ on hydrogen was determined to be 0.72 mb, while the $\Sigma^+ - K^+$ production was found to be less at 2.08 Bev/c than at 1.39 Bev/c. Angular distributions indicate a strong backward tendency for the Σ^+, especially at small angles. The reaction $\pi^+ + p \rightarrow \Lambda^0 + K^+ + \pi^0$ was strongly dominated by Λ-π resonance formation at 1385 Mev, although a collection of events about 1600 Mev was also observed. The Λ^0-π^+ effective mass distribution indicated a very low background at the 1385-Mev Y*. The mass and full width at half maximum of this resonance were determined to be 1382 ± 4 and 28 Mev. The Y* was also produced predominantly in the backward hemisphere in the center of momentum and support for a spin assignment greater than ½ was noted. The Σ^+-π^+ mass distribution for the Σ^+-K^0-π^+ final state showed a broad peak at 1500 Mev. (D.C.W.)

36584 (TID-19343) MULTIPLE PION PRODUCTION IN INTERACTIONS OF POSITIVE PIONS WITH PROTONS NEAR 1.0 Bev. Horst W. J. Foelsche and Henry L. Kraybill (Yale Univ., New Haven). 1963. Contract AT(30-1)-1349. 66p.

Multiple pion production in the reactions $\pi^+ - p \rightarrow p + \pi^+ + \pi^+ + \pi^-$ and $\pi^+ - p \rightarrow p + \pi^+ + \pi^+ + \pi^- + \pi^0$ at 910, 1090, and 1260 Mev was studied. Double pion production is found to be dominated by the production of the well known $(^3/_2,^3/_2)$-isobar and no other resonant states among the outgoing particles can be identified. Triple pion production is found to proceed almost exclusively by the formation of the meson(η) (mass 549.0 Mev) which subsequently decays into $(\pi^+ + \pi^- + \pi^0)$. The isotopic spin of the η is confirmed to be I = 0 and the spin J, parity P, and G-parity G are confirmed to be most likely $J^{PG} = 0^{-+}$. The relative decay rate $\rho = (\eta \rightarrow \pi^+ + \pi^- + \gamma)/(\eta \rightarrow \pi^+ + \pi^- + \pi^0)$ is found to be $\rho = 0.14 \pm 0.08$, and the decay ratio $R = (\eta \rightarrow 3\pi^0)/(\eta \rightarrow \pi^+ + \pi^- + \pi^0)$ is found to be $R \sim 2 \pm 1$. No η's were observed at 910 Mev. At 1090 and 1260 Mev the production angular distributions of the η are roughly isotropic. η-production appears to be associated with the production of the $(^3/_2,^3/_2)$-isobar in the (p,π^+) system. The energy 1090 Mev represents the threshold energy for production of η with isobar, and the η meson appears to emerge with angular momenta higher than $l = 0$. 30 references. (auth)

36585 (TRG-Report-434) TWO MERCURY AUTOCODE PROGRAMMES TO CALCULATE THE ESCAPE PROBABILITIES FOR MULTIREGION INFINITE CYLINDERS. R. I. McLeod (United Kingdom Atomic Energy Authority. Reactor Group, Dounreay, Caithness, Scotland). Nov. 2, 1962. 14p.

Two short Autocode programs that can be used to calculate the escape probabilities for infinite cylinders consisting of concentric annuli are described. One program deals with the case of the central region as a source region, while the second takes one of the annuli as the source region. It is assumed that the attenuation law from a point source to a distance R is of the form $\exp(-\mu R)/4\pi R^2$. (auth)

36586 (UCRL-10813) ELASTIC K^+-PROTON SCATTERING AT 910 Mev/c. POLARIZATION OF THE RECOIL PROTONS (thesis). Warner Hirsch (California. Univ., Berkeley. Lawrence Radiation Lab.). May 1963. Contract W-7405-eng-48. 96p.

The Berkeley 30-in. propane bubble chamber was used to study the elastic K^+-p interaction at 910 Mev/c, in the region of transition from the isotropy in angular distribution found below 810 Mev/c to the rapidly increasing anisotropy above 1 Bev/c. Results based on 1154 events

show that the series ($1 + a \cos \theta_k^{cm}$) can fit the angular distribution with $a = 0.18 \pm 0.05$. Polarization was measured on the secondary proton by using proton-proton and proton-carbon recoils in the liquid of the chamber. A likelihood function using 53 proton-proton and 41 proton-carbon interactions gave these values for the polarization: [$\overline{P}$ ($40° < \theta_k^{cm} < 70°$) = -0.80 ± 0.80; $\overline{P}$ ($70° \leq \theta_k^{cm} < 100°$) = $-0.74 = 0.45$; $\overline{P}$ ($100° \leq \theta_k^{cm} < 140°$) = $+0.55 \pm 0.93$; and $\overline{P}$ ($140° \leq \theta_k^{cm} < 160°$) = $+0.70 \pm 0.93$.] The results of a phase shift analysis incorporating these polarization data are presented. (auth)

36587 (UCRL-10864) BRANCHING RATIO FOR PION-BETA DECAY: $\pi^+ \rightarrow \pi^0 + e^+ + \nu$ (thesis). Robert B. Bacastow (California. Univ., Berkeley. Lawrence Radiation Lab.). June 10, 1963. Contract W-7405-eng-48. 53p.

The branching ratio ($\pi^+ \rightarrow \pi^0 + e^+ + \nu / \pi^+ \rightarrow \mu^+ + \nu$) was measured as a test of the conserved-vector-current (CVC) theory by detecting the π^0-decay gammas and one of the gammas from the positron annihilation. The number of stopped pions counted was 5.6×10^{10}, and the efficiency for detecting the $\pi^0 \rightarrow \pi^0$ decay was 0.32%. Five events were obtained with an estimated background of about one, giving a branching ratio of 2.1×10^{-8} which is consistent with the 1.01×10^{-8} predicted by the CVC theory. 31 references. (auth)

36588 WEAK INTERACTION MEDIATED BY REGGE PARTICLES. Chikashi Iso (Brandeis Univ., Waltham, Mass.). Ann. Phys. (N. Y.), 23: 304-17(Aug. 1963).

Under the assumption that the weak interaction is mediated by Regge type particles, the cross section for $\nu + n \rightarrow p + e^-$ is given. This cross section is remarkably different from that given by the usual weak interaction, if the spin of this particle is one and the slope of the Regge trajectory is comparatively as large as for the strongly interacting particles. Finally the cross sections for weak interactions and strong interactions are compared at high energy when the weak interaction does not have a Regge behavior. (auth)

36589 BREMSSTRAHLUNG IN HIGH ENERGY ELECTRON-ELECTRON SCATTERING WITH CONSIDERATION OF A STRUCTURE OF ELECTRONS. K. Logar and P. Urban (Universität, Graz). Ann. Physik (7), 11: 101-22(1963). (In German)

The Bethe-Heitler formula was always considered adequate for the calculation of the bremsstrahlung of an electron in the field of a second electron. This represents the result of old perturbation calculations in which point particles are taken as a basis. The experiments carried out recently with very high energies gave indications, however, of the presence of a so-called structure that calls for particles with finite, but small, expansion. For the calculation of the bremsstrahlung at high energy of such structure-affected particles, the Weizsacker-Williams method was used so that it was possible to introduce the structure of a charged particle into the calculation. Reference is made to work of Logar and Urban in which the structure-affected charged particles were replaced by their field and these were converted by a Fourier transformation into photons of a suitable energy distribution. These photons then collide with a second congruous electron with the same structure. The effective cross section for the bremsstrahlung results from the effective cross section for the Compton effect, multiplied by the number of equivalent photons, and integrated over the energy of the incident photons. The effective cross section contains three terms: the first corresponds to the point charge (the result agrees with the Bethe-Heitler formula), the second considers the structure of the electron at rest, and the third corresponds to the structure of a high-energy incident electron. (tr-auth)

36590 QUANTUM MECHANICAL MODEL CONSIDERATIONS FOR MULTI-CHANNEL SCATTERING IN NON-LINEAR FIELD THEORIES. Harald Stumpf (Max-Planck-Institut für Physik und Astrophysik, Munich). Ann. Physik (7), 11: 138-50(1963). (In German)

The semiconductor model was interpreted as a non-relativistic analog to the Heisenberg nonlinear spinor theory of elementary particles. Scattering processes were discussed qualitatively within the framework of this model using the stationary Lippmann-Schwinger scattering equations. The scattering states were defined by the elementary electron excitation states of the semiconductor model, that is, polaron and exciton states to which the elementary particles advanced in the relativistic theory (fermion and boson states) correspond in the non-linear spinor theory. As in the elementary particle theory, only asymptotic multipolaron and multiexciton states that diagonalize the total hamiltonian operator can be derived. Analogies to the relativistic case were given for the construction of the S matrix, to which further expansion may be necessary for the development of the scattering theory in the nonlinear spinor theory. (tr-auth)

36591 THE THEORY OF SMALL-ANGLE SCATTERING OF X RADIATION AND NEUTRONS BY DRIFT RINGS. Alfred Seeger and Manfred Ruehle (Technische Hochschule, Stuttgart and Max-Planck-Institut für Metallforschung, Stuttgart). Ann. Physik (7), 11: 216-29(1963). (In German)

The small angle scattering on drift rings has become quite important because of new experiments on quenched and irradiated metals. The general theory given previously was expanded and applied to a series of experimentally interesting cases. The integral intensity of the scattering, the effect of anisotropic elastic properties for cubic crystals, and the scattering with anisotropic distribution of the rings were calculated. The results were compared with the scattering on spherical cavities. (tr-auth)

36592 EXPERIMENT FOR TESTING THE REGGE POLE CHARACTERS OF PHOTONS, ELECTRONS, AND μ MESONS. H. Salecker (Universität, Freiburg i. B. and CERN, Geneva). Ann. Physik (7), 11: 261-76(1963). (In German)

The Regge pole idea represents, in the area of quantum electrodynamics, a new method for testing the present theory that is very different from the form factor tests presently used. The method should be investigated fully as a quantitative testing of quantum electrodynamics. Various experiments for this purpose were proposed and analyzed. Scattering of electrons on nuclei with zero spin and photoproduction of mesons (μ) and electron-positron pairs were shown to be especially suitable. These experiments can expand the knowledge in the available energy range by almost two orders of magnitude. Electron-electron scattering with counter-current beams and two-quantum pair annihilation can be investigated from the same viewpoint. (tr-auth)

36593 SOURCES OF QUASI-MONOENERGETIC γ-RADIATION. PART II. A. H. Aten, Jr. and J. Langelaar (Instituut voor Kernphysisch Onderzoek, Amsterdam). Intern. J. Appl. Radiation Isotopes, 14: 289-90(Aug. 1963). (In English)

The use of Ba^{133} as a source of approximately monoenergetic γ rays is discussed, and the preparation of suitable sources is described. (auth)

36594 CLASSIFICATIONS OF ELEMENTARY PARTICLES. PART I. D. D. Ivanenko and D. F. Kurdgelaidze

(Moscow State Univ.). Izv. Vysshikh Uchebn. Zavedenii, Fiz., No. 3, 153-65(1963). (In Russian)

Elementary particles were classified on the basis of nonlinear field theory, and spectra were developed for fermion, meson, nucleon, and hyperon resonance states. (R.V.J.)

36595 TIME-OF-FLIGHT INVESTIGATIONS OF ELECTRON TRANSPORT IN GASES. G. S. Hurst, L. B. O'Kelly, E. B. Wagner, and J. A. Stockdale (Oak Ridge National Lab., Tenn.). J. Chem. Phys., 39: 1341-5 (Sept. 1, 1963).

Electron swarm experiments may be arranged to satisfy the boundary conditions applicable to a one-dimensional time-dependent transport equation. Under such conditions it may be shown that the distribution of the time-of-arrival of individual electrons at a point on a plane which is L cm from another plane releasing electrons at time t = 0 may be interpreted in terms of the diffusion coefficient D and the drift velocity w. The integrals of the distribution functions, i.e., the total numbers of electrons arriving, before and after the addition of an attaching gas, are directly related to the attachment coefficient, β. Since, in such experiments, time is a more accessible independent variable than is length, it is not surprising that much more information on the basic character of electron transport in gases is obtained than can be obtained from a Townsend experiment. Results for values of D, and w as a function of E/P are given for C_2H_4 and CO_2. (auth)

36596 SCATTERING OF GAMMA-RAYS. I. SCATTERED GAMMA-RAYS IN THE LABYRINTH OF SHIELDED Co^{60} IRRADIATION FACILITIES. II. RADIOGRAPHY USING THE SCATTERED γ-RAYS. Tokishi Kaminishi (Government Industrial Research Inst., Nagoya, Japan). Nagoya Kōgyō Gijutsu Shikensho Hōkoku, 10: 626-35(Oct. 1961). (In Japanese)

The intensities and energy spectra of scattered γ rays in the labyrinth of a 3000-C Co^{60} irradiation facilities were measured by means of chamber-type detectors and a scintillation spectrometer. Problems concerning the radiation differences between the 2 labyrinth sections, the contribution of the scattered-rays to the special dosage rate, and the estimation of the dosage rate were studied. The histories of the scattered rays entering the labyrinth are also discussed. It was confirmed that the soft energy components ranging from 100 to 200 kev in the energy spectrum were due to the multi-scattered photons in the shielding wall. The dosage rate in the labyrinth could be expressed approximately as the following factors; quantities of the source, specific γ-ray emission, 2 geometrical factors determined by the labyrinth shape, and an energy reflecting coefficient. The results agreed with those calculated assuming the geometrical factors were in simple forms. (OID)

36597 THREE-MESON MODEL FOR p-p SCATTERING. R. A. Bryan, C. R. Dismukes, and W. Ramsay (Univ. of California, Los Angeles). Nucl. Phys., 45: 353-68(Aug. 1963). (In English)

The p-p interaction over the 0 to 320 Mev energy range is analyzed in terms of one-boson-exchange potentials. It is found that not unreasonable fits to the P and D state phase shift data can be obtained using one-boson-exchange potentials due to the ρ and ω $J = 1^-$ mesons, the pion and a postulated $J = 0^+$ meson. The fit to the $^1S_0$ data is only qualitative, but this is not unexpected from the standpoint of meson theory. The possible existence of the scalar meson is discussed in the light of present experimental evidence. (auth)

36598 PROTON-DEUTERON SCATTERING AT 77 Mev. M. Davison, H. W. K. Hopkins, L. Lyons, and D. F. Shaw (Nuclear Physics Lab., Oxford). Nucl. Phys., 45: 423-36(Aug. 1963). (In English)

The Oxford 12-cm deuterium bubble chamber was used to examine the reactions $p + d \rightarrow p + d$, $p + d \rightarrow p + p + n$, at an incident proton energy of 77 Mev. The total cross section (excluding elastic scattering below 10° cm) is found to be 146 ± 8 mb. The elastic differential cross section, measured over the angular range 5 to 180° (cm) is compared with the impulse approximation theory. The low statistical accuracy of the experiment does not allow a detailed examination of the inelastic events to be made, but some general features are discussed. Chew-Low extrapolations were performed to determine the free p-p and n-p cross sections. (auth)

36599 MEASUREMENT OF THE POLARIZATION IN PROTON-PROTON SCATTERING AT 30 AND 50 Mev. C. J. Batty (National Inst. for Research in Nuclear Science, Chilton, Berks, Eng.), R. S. Gilmore, and G. H. Stafford. Nucl. Phys., 45: 481-91(Aug. 1963). (In English)

A measurement of the polarization produced in proton-proton scattering at an angle of 45° center-of-mass was made at two energies. At 49.9 Mev the polarization P = 0.0316 ± 0.0017 and at 30.0 Mev, P = −0.0004 ± 0.0033. Using these results and available differential cross section measurements, a phase-shift analysis was carried out to investigate which further measurements are desirable to fix the values of the phase-shifts more accurately. (auth)

36600 DIRECT PAIR PRODUCTION BY COSMIC-RAY MUONS. P. H. Stoker, C. H. Bornman, and J. P. Van der Merwe (Potchefstroom Univ. for C.H.E., South Africa). Nucl. Phys., 45: 505-12(Aug. 1963). (In English)

Direct electron pair production in 0.29 radiation length lead plates contained in a Wilson cloud chamber was investigated for 12082 traversals of cosmic-ray muons with energy more than 1700 Mev. A histogram for transferred energies above 25-Mev was obtained. The results are in agreement with a formula approximated from the theory of Murota, Ueda, and Tanaka. According to a χ^2-test the most probable value for the indefinite constant of the theory is $\alpha = 2$. The results for the energy determination of the knock-on and pair electrons secondary to the muons from absorption and shower curves are consistent with previous experimental work and led to a histogram for the knock-on spectrum in agreement with the theory. (auth)

36601 ON WEAK INTERACTION LAGRANGIANS WHICH VIOLATE THE $|\Delta I| = \frac{1}{2}$ RULE. Dubravko Tadić (Univ. of Birmingham, Eng.). Nucl. Phys., 45: 517-22 (Aug. 1963). (In English)

It is shown that charged baryon currents are sufficient for construction of a Lagrangian with dominant $|\Delta I| = \frac{1}{2}$ and small $|\Delta I| = \frac{3}{2}$ contribution to the nonleptonic decays. Using such a model, it is difficult to reproduce K_{13} decay rates if a $|\Delta I| = \frac{3}{2}$ contribution is totally absent. If a Lagrangian with neutral currents is used, a small admixture of $|\Delta I| = \frac{3}{2}$, which is not in contradiction with the $K_{2\pi}$ decay rates, may be sufficient to describe the K_{13} decays. Any nonsimple structure of lepton currents (e.g., neutrino flip) will alter the conclusions. (auth)

36602 EVOLVING OF A PULSE HEIGHT SPECTRA OBSERVED WITH A SCINTILLATION SPECTROMETER FOR THE ENERGY SPECTRA OF γ RADIATION. Fritz Rau (Technische Hochschule, Munich). Nukleonik, 5: 191-7(Aug. 1963). (In German)

After a short review of other methods for the evaluation of pulse height spectra with a scintillation spectrometer,

an interpolation process is described in which the matrix of the spectral detection probability can be ascertained approximately from the pulse height spectra of fewer standardized radiators. The sought energy spectra were found by multiplication of the observed pulse height spectra by the inverse of this matrix. In this way the γ lines were produced as Gaussian curves which had a characteristic half width for the spectrometer. (tr-auth)

36603 OBSERVABLE CONSEQUENCES OF ANOMALOUS THRESHOLDS. Francis R. Halpern and H. Lee Watson (Univ. of California, San Diego). Phys. Rev., 131: 2674-7(Sept. 15, 1963).

The Landau surface for the triangle diagram touches the physical region at three points. The consequences of this singular-matrix element for several processes are studied. It is found that there should be peaks in cross sections at the edge of phase space. These peaks depend sensitively on the incident energy and are distinguished in this way from genuine resonances. (auth)

36604 METHOD FOR MEASUREMENT OF COUPLING CONSTANTS. Marc Ross (Indiana Univ., Bloomington). Phys. Rev., 131: 2678-81(Sept. 15, 1963).

The possibility of direct experimental determination of certain coupling constants or partial widths is examined. As an illustration of the proposed method the process $p \rightarrow N + \pi$ is discussed in some detail. Among other cases discussed are $\omega \rightarrow \rho + \pi$, $Y_0^* \rightarrow \bar{K} + N$ (to determine the Y_0^* spin), and $\Sigma \rightarrow \Lambda + \pi$. (auth)

36605 Y_0^* AND THE LOW-ENERGY $\bar{K}N$ INTERACTION. Y. Fujii (Nihon Univ., Tokyo). Phys. Rev., 131: 2681-3(Sept. 15, 1963).

An analysis is attempted on the low-energy $\bar{K}N$ data by assuming that the Y_0^* is an S-wave $\bar{K}N$ bound state. Two tentative sets for the scattering lengths are obtained which are similar to that of Akiba and Capps, and fit all the low-energy data reasonably well. (auth)

36606 EMPIRICAL RELATIONS INVOLVING THE HYPERONS AND BARYON ISOBARS. R. M. Sternheimer (Brookhaven National Lab., Upton, N. Y.). Phys. Rev., 131: 2698-2703(Sept. 15, 1963). (BNL-7024)

A scheme for the classification of the nucleon isobars recently proposed by Kycia and Riley is extended to include the hyperon isobars Y_3^* and Y_1^* with strangeness $S = -1$. The present model is essentially based on the existence of empirical mass relations involving the various baryon isobar states. The extent of the validity of these mass relations is discussed. A classification of the six isobar systems which occur in the present scheme is described. We also discuss the set of quantum numbers which is necessary to characterize an isobaric state. (auth)

36607 ASYMPTOTIC PION-PION ELASTIC SCATTERING AMPLITUDE. Robert L. Zimmerman (Univ. of Washington, Seattle). Phys. Rev., 131: 2704-9(Sept. 15, 1963). (TID-19005)

The elastic scattering amplitude for neutral pseudoscalar particles is calculated in the limit of high energies and small momentum transfer. All inelastic channels are kept in the intermediate state by exchanging only two particles. This resulting expression gives the upper and lower bounds on the total cross section $b/s < \sigma(s) < a/s^{\epsilon}$, where $\epsilon > 0$ and a, b are real constants. A special case of this elastic scattering amplitude is shown to be of the form suggested on the basis of the Regge theory of complex angular momentum. If the slope of the Regge trajectory is taken to be $a \simeq /50$ we obtain a total cross section which decreases very slowly $\sigma(s) = (k/16\pi)s^{-0.005}$, where k is some real constant. (auth)

36608 NEUTRAL-PION PRODUCTION FROM PROTON-PROTON COLLISIONS AT 735 Mev. Robert J. Cence, Don L. Lind, Gilbert D. Mead, and Burton J. Moyer (Univ. of California, Berkeley). Phys. Rev., 131: 2713-18(Sept. 15, 1963). (UCRL-10621)

An investigation was made of the reaction $p + p \rightarrow p + p + \pi^0$ at an incident proton energy of 735 Mev. The external proton beam of the 184-in. synchrocyclotron bombarded a liquid-hydrogen target. Gamma-ray energy spectra were measured at laboratory angles of 6, 32, and 60 deg with respect to the proton beam. Two high-resolution pair spectrometers were used to make these measurements. Computer codes were used to make all necessary corrections to the data and determine the final spectra. No evidence is found for high-energy gamma rays produced from any source other than neutral-pion decay. The cross section for π^0 production was measured to be 3.46 ± 0.25 mb. By use of the method of least squares, angular and momentum distributions of the neutral pion in the two-proton barycentric system were determined from the photon spectra. The pion angular distribution is given by $d\sigma_\pi^0/d\Omega = (\sigma_T/4\pi)[0.834 + 0.099(3\cos^2\theta) + 0.067(5\cos^4\theta)]$, where θ is the barycentric angle of emission. Pion momentum distributions are given for three angles. The results are shown to give reasonable agreement with the isobar model. (auth)

36609 A FIELD THEORY OF WEAK INTERACTIONS. [PART] I. G. Feinberg (Columbia Univ., New York) and A. Pais. Phys. Rev., 131: 2724-61(Sept. 15, 1963).

Higher order weak-interaction effects are studied in the framework of vector meson field theory. It is found that such effects may be observable even at low energy. The cause of this can be traced precisely to the unrenormalizability of the theory in the sense of conventional perturbation expansions. These expansions are circumvented by new techniques for summing the most singular parts of perturbation graphs. In this first paper we study in detail the infinite subset of uncrossed ladder graphs. Purely leptonic processes are considered to begin with. The corresponding Bethe-Salpeter equation is soluble by a new iteration scheme. In leading order we reproduce the conventional zero-energy results provided g^2 is replaced by $3g^2/4$. (g = bare meson-lepton coupling constant.) An argument is presented which leads to the conjecture that this result is valid for larger classes of graphs. However, there exist energy-dependent deviations from the conventional second-order results. These are in principle observable in μ decay. The applicability of the theory to semileptonic and nonleptonic phenomena depends on properties of the baryon and meson currents and on the effects of the strong interactions. Preliminary considerations along these lines are given. (auth)

36610 GENERALIZATION OF MASS FORMULA IN UNITARY SYMMETRIES. Muneer Ahmad Rashid and Iwao Yamanaka (Imperial Coll. of Science and Tech., London). Phys. Rev., 131: 2797-2802(Sept. 15, 1963).

Okubo's mass formula for unitary symmetries is generalized to any order. It is shown that the number of terms in a formula for a representation true to all orders is exactly the same as the number of isotopic multiplets contained in the representation. This result also holds for strong interaction symmetries based on other rank-2 groups. (auth)

36611 POSSIBLE TEST OF THE VECTOR NATURE OF STRONG INTERACTIONS. K. E. Eriksson and S. A. Yngstroem (Uppsala Univ.). Phys. Rev., 131: 2805-8 (Sept. 15, 1963).

A vector theory of the interaction between baryon cur-

rents implies the presence of soft-meson radiation in high-energy processes. It is shown that perturbation theory can be used to calculate branching ratios for such radiation in the center of mass system. It is also shown that soft mesons are emitted independently of each other. Formulas are derived for the branching ratios. It is suggested that these formulas could be used to determine the ω-baryon coupling constant, if the ω field is the field that interacts with the baryon current. (auth)

36612 REMARKS CONCERNING POSSIBLE HIGHER RESONANCES IN THE UNITARY SYMMETRY MODEL. S. Gasiorowicz (Univ. of Minnesota, Minneapolis). Phys. Rev., 131: 2808-9(Sept. 15, 1963).

A resonance which decays into a meson and one of the $J = {}^3/_2{}^+$ isobars may, according to the unitary symmetry scheme, belong to any one of the irreducible representations 8, 10, 27, or 35. Even if only a Y = 1 member of the supermultiplet is detected, it is still possible to determine the dimensionality of the representation by the study of the ratios between the partial widths for decays into different isobar-meson channels. (auth)

36613 REPRESENTATIONS OF THE LORENTZ GROUP CORRESPONDING TO UNSTABLE PARTICLES. Daniel Zwanziger (Università, Rome). Phys. Rev., 131: 2818-19(Sept. 15, 1963).

The irreducible nonunitary representations of the inhomogeneous Lorentz group, which satisfy the condition that the complex energy-momentum 4 vectors be transformable into a rest frame by a real Lorentz rotation, are found. By explicit construction of wave packets in configuration space it is seen that the vectors of the representation space have a natural interpretation as states of unstable particles. The new representations arise in the study of complex singularities associated with resonance poles in analytically continued scattering amplitudes. (auth)

36614 INDUCED GAMMA-RAY EMISSION. G. C. Baldwin, J. P. Neissel, and L. Tonks (General Electric Co., Schenectady, N. Y.). Proc. IEEE (Inst. Elec. Electron. Engrs.), 51: 1247-8(Sept. 1963).

The theoretical considerations concerning the size and constitution of a reactor for production of a nuclear-reaction-induced gamma-maser effect are discussed. (T.F.H.)

36615 THE RADIATIVE DECAY OF AN ω PARTICLE. Yuan-beng Dai. Sci. Sinica (Peking), 12: 1111-16(Aug. 1963). (In English)

A dispersion relation for the process $\omega \rightarrow \pi + \gamma$ is obtained by analytical continuation with respect to the ω mass. Some problems concerning dispersion relations involving unstable particles are discussed. Under simplified assumptions $(W_{\omega\rightarrow\pi+\gamma})/(W_{\omega\rightarrow 3\pi}) = 0.38$ and $(W_{\eta\rightarrow\pi+\gamma})/(W_{\eta\rightarrow 3\pi}) = 25$ are obtained, where η is assumed to have the same quantum numbers as ω. The effect of the interaction in pairs between three pairs is included in the calculation. (auth)

36616 ANGULAR DISTRIBUTION OF COMPTON SCATTERED Co^{60} PHOTONS. A. M. Ghose. Trans. Bose Res. Inst. (Calcutta), 25: 73-80(1962).

Relative values of the differential collision cross-section for the γ rays of Co^{60} (1.17 and 1.33 Mev) were measured in the angular range of 13 to 140°. A new type of detector, the efficiency of which remains nearly constant for the secondary photons in the range investigated, was used. Errors caused by multiple scattering and absorption in the scatterer were eliminated by an extrapolation procedure. Corrections were made for effects arising from self-absorption in the source. Experimental data favor the Klein-Nishina formula. The experimental data agree with the latter within the range of experimental error, which is less than ± 5% for most of the angles studied. Assuming the validity of the Klein-Nishina formula, the experimental data were utilized to derive the relative spectral response of the special type of counter used. (P.C.H.)

36617 ON POLARIZATION PROPERTIES OF ELECTRONS IN μ^+ MESON DECAY. [PART] II. B. K. Kerimov, Yu. A. Popov, and Yu. M. Loskutov. Vestn. Mosk. Univ., Ser. III, Fiz. Astron., No. 1, 62-5(Jan.-Feb. 1963). (In Russian)

Formulas were derived for determining longitudinal and transverse polarization and non-polarization of electrons in μ meson decay. (tr-auth)

36618 AMPLITUDE OF DISPERSION IN QUASI-CLASSICAL APPROXIMATION. Yu. G. Pavlenko. Vestn. Mosk. Univ., Ser. III, Fiz. Astron., No. 3, 70-4(May-June 1963). (In Russian)

An integral equation equivalent to the Schroedinger equation was used to develop additional data on dispersion amplitudes in quasi-classical approximation. (R.V.J.)

36619 QUANTUM THEORY MODEL OF FIELDS WITH N-FIXED FERMIONS. V. A. Gorodtsov. Vestn. Mosk. Univ., Ser. III, Fiz. Astron., No. 3, 75-80(May-June 1963). (In Russian)

A simplified field model with nucleon (fermion) exchange with μ mesons without recoil (nucleons are infinitely heavy $M \rightarrow \infty$) was developed. Such nucleon models are considered nonrelativistic and include a factor forbidding interactions with high-energy mesons. An analysis of such models produced the concept of peripheral processes in real fermions. Calculations considering quantization and boson number concepts are used in an investigation of non-stationary processes. (R.V.J.)

36620 ON THE EFFECTS OF THE IMPACT PARAMETER ON MULTIPLE PRODUCTION OF PARTICLES. V. V. Alekseev. Vestn. Mosk. Univ., Ser. III, Fiz. Astron., No. 3, 81-4(May-June 1963). (In Russian)

Studies of multiple production of particles as a function of shock parameters (peripheral or frontal) in meson incidence showed that the multiplicity is proportional to the coefficient of inelasticity (or shock parameter). The problem is resolved within a system of spherical coordinates using perturbation theory and considering meson-nucleon interactions limited only by nucleon rotational freedom. (R.V.J.)

36621 INTERFERENCE EFFECTS OF RADIATION IN LAMINATED MEDIA. V. E. Parfumov (Lebedev Inst. of Physics, Moscow). Zh. Tekhn. Fiz., 33: 557-60(May 1963). (In Russian)

Angular distributions of radiation emission by charged particles in flight through dielectric, ferrodielectric, and crystalline plates were estimated. Dispersion equations were developed for the case in which the group velocity is negative. An analysis was made of Brewster's angle of emission. (tr-auth)

36622 CHERENKOV EMISSION BY CHARGED PARTICLES MOVING ALONG A CYCLE IN CURVED RECTANGULAR DIAPHRAGMED WAVE-GUIDE. A. N. Didenko (Tomsk Polytechnic Inst., USSR). Zh. Tekhn. Fiz., 33: 731-4(June 1963). (In Russian)

Cherenkov emission of particles moving in a cycle around a curved, diaphragmed waveguide was studied in order to determine the feasibility of using Cherenkov

emissions for generating radio waves and injecting particles into constant magnetic fields. (R.V.J.)

36623 HIGH-ENERGY NUCLEON COMPTON SCATTERING. Jonas Stasys Zmuidzinas (California Inst. of Tech., Pasadena). 122p. (CONF-78-11)

From American Physical Society 1963 Summer Meeting, Buffalo, June 1963.

The high-energy nucleon Compton scattering process is studied to second order in the electromagnetic coupling constant from the viewpoint of complex angular momenta. Assuming the validity of the Regge hypothesis about the asymptotic behavior of scattering amplitudes, formulae for total and differential cross sections in the forward and backward directions are derived. Residues of Regge poles in their physical regions are estimated on the basis of existing experimental data. The implications of possible Regge cuts are discussed. (auth)

36624 POSSIBLE EXISTENCE OF ISOBAR MECHANISM PEAK Ξ^{**}. S. F. Tuan (Purdue Univ., Lafayette, Ind.). 6p. (CONF-46-18)

From American Physical Society Meeting, Washington, D. C., Apr. 1963.

The possible existence of an isobar peak Ξ^{**} at higher energy to correspond to the first Ξ^{*} at 1535 Mev is considered. This isobar peak of width $\Gamma \lesssim 12$ Mev and with position 1745 Mev is predicted at a somewhat higher energy than that expected from unitary symmetry mass formula considerations. In order to synthesize the two predictions, it is concluded that the mass formula for the $^3/_2^-$ octet is perturbed, as is known for the vector meson case. This peak should be amenable to experimental discovery from reactions like $K^- + p \rightarrow K^+ + \Xi^{**}$. (A.G.W.)

Neutron Physics

36625 (AAEC/TM-203) AN EXPERIMENTAL DETERMINATION OF THE DIFFUSION LENGTH OF THERMAL NEUTRONS IN BERYLLIUM OXIDE. E. Brittliff, P. Duerden, and D. B. McCulloch (Australia. Atomic Energy Commission Research Establishment, Lucas Heights, New South Wales). June 1963. 15p.

The diffusion length of thermal neutrons in beryllium oxide of effective density 2.86 g cm^{-3} was measured as 29.9 ± 0.8 cm. Using published experimental values for the diffusion constant of beryllium oxide, a value of σ_a = 9.0 ± 0.5 mb is deduced for the effective 2200m/s microscopic absorption cross-section. (auth)

36626 (AEEW-R-273) THE WINFRITH DSN PROGRAMME. S. Francescon (United Kingdom Atomic Energy Authority. Reactor Group. Atomic Energy Establishment, Winfrith, Dorset, England). May 1963. 26p.

The program, which is written in the Fortran language, solves the Carlson discrete S_n approximation to the Boltzmann transport equation in cylindrical geometry. The input and output facilities of the Winfrith DSN program and the associated editing program WED are described. (auth)

36627 (CRRP-1159) APOGEE: A COMPUTER PROGRAM TO SOLVE THE ONE GROUP NEUTRON DIFFUSION EQUATION IN THREE DIMENSIONS. A. P. Olson (Atomic Energy of Canada Ltd., Chalk River, Ont.). July 1963. 83p. (AECL-1799)

The computer program APOGEE, in SNAP for the Chalk River G-20 computer, solves the one-group neutron diffusion equation by finite-difference approximations on a three-dimensional uniform mesh of common spacings in two dimensions. Mesh geometries approximating either the NPD- or CANDU-type lattice can be used. The calculational procedures are discussed, particularly the treatment of physical boundaries; and case preparation is demonstrated. Flux, reactivity, and power distribution calculations showing good agreement with experiment are included. (D.C.W.)

36628 (ORNL-TM-646) FAST-NEUTRON DOSE RATES BEHIND SLABS OF WATER AND OF CONCRETE: COMPARISON OF ORNL-TSF EXPERIMENTAL RESULTS WITH CALCULATIONS. R. M. Freestone, Jr. (Oak Ridge National Lab., Tenn.). Sept. 9, 1963. Contract [W-7405-eng-26]. 9p.

Neutron dose transmission factors by Monte Carlo methods were used to compute the dose rate behind various thicknesses of water and concrete. The dose rate incident upon the slabs was computed by applying first-collision flux-to-dose conversion factors to a measured spectrum of the ORNL TSR-II reactor. The results of the calculation were compared with experimental measurements made at the ORNL Tower Shielding Facility for neutrons incident at 0 to 70 deg from the normal on slabs of water from 0 to 18 in. thick, and for incidence angles of 0, 45, and 75 deg on concrete slabs from 0 to 18 in. thick. Computed fast-neutron dose rates decrease more rapidly with thickness than do experimental dose rates, the worst case being a factor of $2^1/_2$ lower at a slab thickness of 18 in. The major part of the disagreement is attributed to unavoidable differences between the conditions of the experiment and those of the calculation. (auth)

36629 (PAN-255) THE SCATTERING OF SLOW NEUTRONS BY MOLECULES. J. A. Janik and A. Kowalska (Polish Academy of Sciences. Inst. of Nuclear Physics, Krakow). Apr. 1963. 164p.

Theories on neutron scattering in molecular systems are described and compared with experimental results on cross sections, angular distributions, and energy distributions for scattering by gases, liquids, and solids. Possibilities of obtaining information on the dynamics of molecular groups from neutron experiments are also considered. 102 references. (auth)

36630 (TID-17871) QUASI-ELASTIC SCATTERING OF COLD NEUTRONS IN WATER. K. S. Singwi (Argonne National Lab., Ill.). Nov. 1962. Contract [W-31-109-eng-38]. 9p. (UAC-7061)

Experimentally, the diffusion broadening of the quasi-elastic peak has been found to be much less than expected on the basis of a simple diffusion model, and extremely small energy transfers (interpreted as small peaks) were observed. Structure was also recently noted in the peak. It is shown that these results follow, in general, very simply from a quasi-crystalline model of water. (D.C.W.)

36631 NEUTRON NEGATIVE SOURCE EXPERIMENT. Ernest Mathieson (The University Leicester, Eng.). Am. J. Phys., 31: 730(Sept. 1963).

A simple experiment is described for measuring, with limited accuracy, the diffusion length of thermal neutrons in polythene. The method uses activation of Ag foils in stacks of polythene foils exposed to neutrons from a Po–Be source. Effects of "negative sources" are taken into account. (T.F.H.)

36632 METHOD FOR THE AMPLIFICATION OF A NEUTRON CURRENT. (to Siemens-Schuckertwerke AG). German Patent 1,111,304. July 20, 1961. Filed Apr. 23, 1960. Kernenergie, 6: 366(July 1963). (In German)

Usual neutron sources, such as a Ra–Be source, are not satisfactory in all cases so that under certain circum-

stances use must be made of a neutron amplifier. A method for the amplification of a neutron current is given. The current can be modulated in either amplitude or frequency. (J.S.R.)

36633 THE SPECTRUM OF NEUTRONS SLOWING DOWN NEAR AN INTERFACE. J. Lewins. Nucl. Energy, 262-5(Sept. 1963).

A variational principle is written for the continuous slowing-down of neutrons in a scattering and lightly absorbing system where the properties are not uniform. Using the semi-direct method, the partial differential equation is reduced to an ordinary differential equation. To do this, trial functions are assumed, composed of arbitrary mixtures of the neutron spectra appropriate to infinite amounts of each property region. A particular example is treated, consisting of two adjacent semi-infinite regions. The solution to the reduced equation is given explicitly so that the problem degenerates to evaluating weighted or effective coefficients of the region properties, and this can be done by quadratures if necessary. To illustrate typical results, certain further approximations are being made enabling a specific solution to be found in terms of the resonance escape probability and the Fermi-age for each region. The method is found to save computation compared to the direct solution of the original partial differential equation, and can be applied to a range of problems where a change of properties produces a spatial variation of the spectrum during slowing-down. (auth)

36634 SMALL-ENERGY ROTATIONAL TRANSITIONS IN SLOW-NEUTRON SCATTERING BY WATER. Sidney Yip and R. K. Osborn (Univ. of Michigan, Ann Arbor). Phys. Rev., 131: 2547-9(Sept. 15, 1963).

A model, which treats one rotational degree of freedom as hindered and the other as free and all translational degrees of freedom as hindered, was employed to calculate neutron differential scattering cross section of water in the region of small-energy transfers. The distribution is found to be sensitive to the presence of free-rotation transitions. It is suggested that such transitions present additional complexities in the study of molecular center-of-mass motions from high-resolution scattering data. (auth)

36635 CALIBRATION OF THE A. P. I. NEUTRON SOURCE. Albert Thomas Fromhold, Jr. Thesis. Auburn, Ala., Auburn Univ., 1958. 76p.

An absolute calibration of a radium-beryllium neutron source showed the strength to be 1.45×10^7 neutrons/second. The calibration technique consisted in neutron absorption by a manganese solution with subsequent measurement of the beta activity of the solution. Equations were derived to compute neutron source strength directly from the experimentally measured beta activity of the solution for a known time of submersion of the neutron source in the solution. Appropriate corrections were made to convert relative measurements to absolute values. A procedure was derived for obtaining the average solid angle subtended from any one-dimensional geometry by a finite plane in order to find the correction factor for counter geometry. The measured source strength agreed with the value 1.3×10^7 neutrons/second obtained from an empirical formula. (auth)

Nuclear Properties and Reactions

Refer also to abstract 36112.

36636 (AD-293985) FINAL REPORT ON THE SCIENTIFIC ACTIVITY [ON NUCLEAR RESEARCH]. R. Levi Steel and V. L. Telegdi (Chicago. Univ. Enrico Fermi Inst. for Nuclear Studies). [1962]. Contract AF49(638)-209. 12p.

A brief survey is presented of the main accomplishments of the Nuclear Emulsion Group in its study of hypernuclei. The Λ-N interaction was found to be charge symmetric and spin dependent, and the weak Λ-N interaction and (Σ^-n) hyperfragments are discussed briefly. New techniques in nuclear emulsions are described. Bibliographies of publications and conference reports are included. (D.L.C.)

36637 (AERI-P/R-3) INTERPRETATION OF THE INELASTIC INTERACTION OF 28 Gev PROTONS WITH G-5 EMULSION NUCLEI BY THE SIMPLE OPTICAL MODEL OF THE NUCLEUS. Lee Yung Jae (Atomic Energy Research Inst., Seoul, Korea). Oct. 27, 1962. 4p.

The characteristics of the inelastic interactions that were found in G-5 emulsion exposed in diffracted proton beam from Brookhaven AGS machine were studied. The interaction mean free path of the proton beam in emulsion is $\lambda_a = (37.6 \pm 1.3)$ cm which corresponds to the absorption coefficient of nuclear matter $K = 2.75 \times 10^{12}$ cm^{-1} and the imaginary part of the complex potential of the simple optical model of the nucleus is computed to be $V_{im} = 42.0$ Mev. (auth)

36638 (AWRE-0-70/63) THE ALDERMASTON NUCLEAR DATA LIBRARY AS AT MAY 1963. K. Parker (United Kingdom Atomic Energy Authority. Weapons Group. Atomic Weapons Research Establishment, Aldermaston, Berks, England). Sept. 1963. 64p.

A guide to the contents and conventions of the Aldermaston Nuclear Data Library that consists principally of cross-sections and related data for neutrons of energies up to 14 Mev is presented. (auth)

36639 (BNL-7160) CONSTRUCTION OF AN EXTENDED NUCLIDIC MASS TABLE. Manny Hillman (Brookhaven National Lab., Upton, N. Y.). [July 9, 1963]. Contract [AT(30-2)-Gen-16]. 13p. (CONF-52-4)

From Proceedings of the Second International Conference on Nuclidic Masses, Vienna, July 1963.

A parabolic systematics approach was used to construct an extended mass table with very small deviations between the calculated and known masses. The masses were obtained from a formula parabolic in 2 after inclusion of the necessary considerations. For 763 masses, the standard deviation was 0.35 Mev, and the largest deviation was 2 Mev. (D.C.W.)

36640 (CERN-63-28) 1963 INTERNATIONAL CONFERENCE ON HIGH ENERGY PHYSICS AND NUCLEAR STRUCTURE HELD AT CERN, FEBRUARY 25–MARCH 1, 1963. Torleif Ericson, ed. (European Organization for Nuclear Research, Geneva). July 1963. 195p.

Separate abstracts were prepared for seven papers on the investigation of nuclear properties with electrons, mesons(μ), mesons(π), strange particles, and protons, and on fragmentation in high-energy nuclear reactions. Use of complex nuclei to examine strange particles is also treated. (D.C.W.)

36641 (CERN-63-28(p.1-36)) COMPLEX NUCLEI AND STRANGE PARTICLES. D. H. Wilkinson (Oxford Univ.).

Methods by which strange particles might be used to study the structure of complex nuclei and ways in which complex nuclei can give information on strange particles are considered. (D.C.W.)

36642 (CERN-63-28(p.37-46)) NUCLEAR STRUCTURE INFORMATION FROM HIGH-ENERGY ELECTRON

SCATTERING. H. W. Kendall (Massachusetts Inst. of Tech., Cambridge).

The types of nuclear information that can be obtained by high energy electron scattering are summarized, and problems associated with the performance and analysis of such experiments are discussed. (D.C.W.)

36643 (CERN-63-28(p.47-72)) INTERACTIONS OF PIONS WITH COMPLEX NUCLEI. Torleif Ericson (European Organization for Nuclear Research, Geneva).

The suitability of very intense pion beams for studying nuclear properties is outlined, and the information that can be obtained by various types of experiments is discussed. Aspects of performing and interpreting certain experiments are also considered. (D.C.W.)

36644 (CERN-63-28(p.73-104)) REACTIONS OF HIGH-ENERGY NUCLEONS, DEUTERONS AND ALPHA PARTICLES WITH NUCLEI. A. B. Clegg (Oxford Univ.).

The information on nuclear properties that can be gained by studying proton reactions and scattering is illustrated by reviewing some research. The experimental results, their agreement with theory, their analysis, and the information derived are considered. Inelastic scattering as a research tool is particularly emphasized. (D.C.W.)

36645 (CERN-63-28(p.105-42)) FRAGMENTATION INDUCED BY HIGH-ENERGY PARTICLES. N. A. Perfilov (Akademiya Nauk S.S.S.R. Institut Radievyi).

Experimental information on fragment emission in nuclear reactions is reviewed, and possible mechanisms for the fragmentation process are discussed. Investigations on the fragmentation of light nuclei that yield information about the mechanism are also considered. 76 references. (D.C.W.)

36646 (CERN-63-28(p.143-71)) MUONS AND NUCLEAR STRUCTURE. J. C. Sens (European Organization for Nuclear Research, Geneva).

The properties of the meson(μ), particularly those permitting its use in nuclear structure studies, are summarized. Theory behind the use of muonic x rays and muon capture by nuclei for such studies is presented along with some experimental results. (D.C.W.)

36647 (CERN-63-28(p.175-84)) CONCLUDING REMARKS [AT CERN CONFERENCE 1963]. R. E. Peierls (Birmingham. Univ., England).

The information on nuclear structure that can be or has been obtained using techniques discussed in the preceding papers is summarized, and problems in analyzing the experimental data are considered. (D.C.W.)

36648 (CONF-46-93) THE FIRST EXCITED STATE OF He^5. Peter Fessenden and D. R. Maxson (Brown Univ., Providence). [nd]. Contract AT(20-1)-1772. 39p.

From American Physical Society 1963 Spring Meeting, Washington, D. C., Apr. 1963.

The reaction $Li^7[d,\alpha)He^5$ was studied using coincidence circuitry and solid state charged particle detectors. Targets of natural and isotopic Li were bombarded with 150–200 kev deuterons, and α-particles emitted at laboratory angles of 90 degrees ond 82 degrees were detected in coincidence. The (d,α) reaction proceeding to the ground state of He^5 was observed. Its differential cross section at 90 degrees was measured relative to that for $Li^6(d,\alpha)\alpha$, and a value of 2.4 was assigned to the parameter A in the function $f(\theta) = 1 + A\sin^2\theta$ that describes the center of mass α-particle distribution resulting from the disintegration of He^5. The first excited state of He^5 was found to have an excitation energy of 2.6 ± 0.4 Mev. The intensity of the excited state alpha group was greater than that of the ground state group by a factor of about 1.5. There was no evidence for any other excited state up to at least 7 Mev. The ratio of the differential cross sections at 90 degrees for $Li^6(d,p)Li^7$ and $Li^6(d,\alpha)\alpha$ was determined for deuteron energies and found to agree with reported cross section data. 30 references. (auth)

36649 (CONF-62-12) NEUTRON TRANSFER IN THE $Pb^{207}(N^{14},N^{13})Pb^{208}$ REACTION. T. L. Watts and J. A. McIntyre (Yale Univ., New Haven). Apr. 1963. Contract [AT(30-1)-13491]. 11p.

From 3rd Conference on Reactions Between Complex Nuclei, Asilomar, Calif., Apr. 1963.

The energy spectrum of the N^{13} reaction products was obtained by the usual procedure for reactions at 132 Mev that left the final nuclei in their ground state. The experimental angular distribution for transfer to the Pb^{208} ground state diverged strongly from the calculations of Breit and Ebel (tunneling) and Greider (quantum-mechanical long-range approximation). Inclusion of nuclear absorption and the presence of a peak at forward angles in the angular distribution are likely explanations for the discrepancy. (D.C.W.)

36650 (CONF-62-13) NEUTRON TRANSFER IN THE $N^{14}(N^{14},N^{13})N^{15}$ REACTION. L. C. Becker, F. C. Jobes, and J. A. McIntyre (Yale Univ., New Haven). Apr. 1963. Contract [AT(30-1)-1349]. 15p.

From 3rd Conference on Reactions Between Complex Nuclei, Asilomar, Calif., Apr. 1963.

The $N^{14}(N^{14},N^{13})N^{15}$ reaction was studied at a low (12-Mev) bombarding energy to exclude nuclear absorption. The N^{13} nuclei ranges were consistent with transfer of the neutron to the N^{15} ground state. Also, the experimental differential cross section was described quite well by a simple theory (Greiders'), in distinct contrast to results previously obtained at higher energies. (D.C.W.)

36651 (EFINS-62-71) THICK TARGET RECOIL MEASUREMENTS. John A. Panontin and Nathan Sugarman (Chicago. Univ. Enrico Fermi Inst. for Nuclear Studies and Chicago. Univ.). [1961]. Contract [AT(11-1)-241]. 52p.

Corrections for scattering and edge effects affecting thick target recoil results in fission studies are presented. Measurement of the range dispersion of Sr^{89} and Mo^{99} from thermal neutron fission of U^{235} yields 18.2 ± 0.8 and 19.9 ± 0.5%, respectively, for the ratio of the full-width at half maximum of the range distribution in Al to the mean range, assuming a Gaussian form for the distribution. Similar determinations for Cu^{67}, Sr^{89}, and Mo^{99} from 450-Mev proton fission of U give 27.2 ± 6.3, 25.9 ± 1.4, and 23.8 ± 0.6%, respectively. The ratio of ranges in the target material, for a thick target, relative to Al are presented for fragments from thermal neutron fission of U and 450-Mev proton fission of U, Bi, and Ta. The ranges in Al determined by the thick target technique compare favorably with those obtained by the thin target technique. (auth)

36652 (EIR-55) INHERENT UNCERTAINTIES IN RESONANCE CALCULATIONS. R. Vernon (Switzerland. Eidgenossisches Institut fur Reaktorforschung, Wurenlingen). July 1963. 14p.

The effective resonance integrals and temperature coefficients of U^{238} and Th^{232} were calculated. The neutron widths used are listed, and the procedure is outlined. The results for U^{238} agree very well with measured values, while the Th^{232} values show poor agreement. The inherent uncertainties imposed by the input data were also evaluated. More accurate determinations of the gamma widths

are needed to permit accurate calculations for thorium. (D.C.W.)

36653 (EUR-119.e) COMPILATION OF CROSS-SECTIONS FOR SOME NEUTRON INDUCED THRESHOLD REACTIONS. H. Liskien and A. Paulsen (European Atomic Energy Community. Central Nuclear Measurements Bureau, Geel, Belgium). July 1962.

The cross sections for some neutron threshold reactions in Na^{23}, Si^{28}, Co^{59}, Ni^{58}, Cu^{63}, Cu^{65}, and Zn^{64} at (generally) 10 to 20 Mev are compiled. Comments on the measuring techniques and accuracies, Q-values for these and other threshold reactions, and information on the data of the various contributors is included. (D.C.W.)

36654 (HW-SA-2840) EFFECTIVE RESONANCE INTEGRAL FOR Pu^{240} IN PLUTONIUM ALUMINUM ALLOY RODS. P. F. Nichols (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). [Nov. 15, 1962]. Contract AT(45-1)-1350. 21p.

Reactivity measurements were made on a set of Pu–Al rods as a function of Pu^{240} concentration. The samples were enclosed in a Cd cover while the measurements were being made. The data obtained from the Physical Constants Testing Reactor were the differences in reactivity between pairs of Cd covered Pu–Al rods that differed significantly only in the Pu^{240} concentration. The sensitivity of the reactor to absorption of epicadmium neutrons in Pu^{240} was obtained by calibrating the system with three sets of Pu–Al rods that were very nearly dilute in Pu^{240} concentration. As a result, these measurements yield effective resonance integrals of Pu^{240} for the various rods relative to the dilute value of the resonance integral. The effective resonance integral for the rod with the highest Pu^{240} concentration is a factor of about seven smaller than the dilute integral. (auth)

36655 (IITRI-A6034-1) THE ANGULAR DISTRIBUTION OF GAMMA RAYS FROM NUCLEI WITH HIGH ANGULAR MOMENTUM. Daniel Sperber (Illinois Inst. of Tech., Chicago. IIT Research Inst.). July 22, 1963. Contract AT(11-1)-578. 11p.

A method is developed for calculating the angular distribution and spectrum of the gamma cascade emitted by an excited nucleus that has previously emitted neutrons with little angular momentum. The transition probability is calculated without resorting to the cross section for the inverse process. (D.C.W.)

36656 (JINR-D-1324) MEASUREMENT OF THE TOTAL MUON CAPTURE RATE IN HELIUM-3. O. A. Zaimidoroga, M. M. Kulyukin, B. Pontecorvo, R. M. Sulyaev, I. V. Falomkin, A. I. Filippov, V. M. Tsupko-Sitnikov, and Yu. A. Scherbakov (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Nuclear Problems). 1963. 8p.

By using a high pressure diffusion cloud chamber the total capture rate for muons in helium-3 was measured to be $\lambda = \exp (2140 \pm 200)\ \sec^{-1}$. This result is in agreement with Primakof's calculations done on the basis of Universal Fermi interaction theory. (auth)

36657 (JINR-P-1347) REAKTSIYA POLNOGO SLIZANIYA YADER. (Reaction of a Complete Nuclear Fusion). B. N. Kalinkin and I. Z. Petkov (Joint Inst. for Nuclear Research, Dubna, U.S.S.R. Lab. of Theoretical Physics). 1963. 13p.

The effect of large angular momenta on the compound nucleus formation in reactions induced by heavy ions is taken into account. (auth)

36658 (LADC-5951) GENERAL INTRODUCTION TO NUCLEAR PHYSICS WITH THERMAL NEUTRONS. H. Motz (Los Alamos Scientific Lab., N. Mex.). [nd]. Contract [W-7405-eng-36]. 4p.

The usefulness and some uses (both practical and impractical) of thermal neutrons for nuclear research are surveyed. Some work already performed is mentioned. (D.C.W.)

36659 (LADC-5952) INTRODUCTION TO THERMAL NEUTRON CAPTURE GAMMA-RAYS. H. Motz and G. Baeckstroem (Los Alamos Scientific Lab., N. Mex.). [nd]. Contract [W-7405-eng-36]. 10p.

Experimental arrangements, equipment, techniques, and reasons for obtaining neutron capture gamma spectra are discussed. The capture process and its merits for studying energy levels are also considered. (D.C.W.)

36660 (NAA-SR-Memo-8690) THE DOPPLER EFFECT OF U-238, Th AND Au. J. M. Otter (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). July 2, 1963. Contract [AT(11-1)-Gen-8]. 30p.

Theoretical values of resonance integrals and Doppler coefficients of U-238, Th, and Au were found using recently improved, yet efficient, calculational procedures. A range of effective scattering cross section per atom from infinity to very small values, and a wide temperature range were investigated. The mathematical representations and sources of physical parameters are reviewed. The Doppler coefficient was found to exhibit a maximum at an intermediate value of self-shielding, which is determined primarily by the properties of the lowest energy resonances. Two parameter fits were made to both resonance integrals and Doppler effect coefficients for practical rod sizes. Comparison with recent experiments showed significant lack of correlation with theoretical calculations for the thorium resonance integral and the U-238 Doppler coefficient. (auth)

36661 (PUC-1962-90) A SCATTERING PROBLEM EXHIBITING NARROW RESONANCES. Larry Zamick (Princeton Univ., N. J. Palmer Physical Lab.). Nov. 19, 1962. Contract [AT(30-1)-937]. 11p.

A solvable scattering problem that exhibits narrow resonances such as are found in the case of nucleon-nucleus scattering is considered. The target in this scattering problem is represented as a two channel system, possessing a ground state and one excited state. The coupling between the ground state and the excited state is shown to produce these resonances. A specific example that exhibits a narrow resonance is solved. (auth)

36662 (TID-17785) ACCURACY OF THE RANDOM-PHASE APPROXIMATION IN NUCLEAR SPECTROSCOPY. S. Cohen, R. D. Lawson, and M. Soga (Argonne National Lab., Ill.). Oct. 1962. Contract [W-31-109-eng-38]. 7p. (UAC-6982)

The random-phase approximation formulated by Baranger for calculating properties of the low-lying states of nuclei is demonstrated to provide poor agreement with the exact calculation. The energy differences between excited states obtained by this formalism are shown to differ from those given by an exact calculation by as much as 1 Mev when a conventional two-body interaction is used and by considerably more than this when a pairing plus quadrupole force is operative. (D.C.W.)

36663 (TID-19329) π^--NUCLEUS INTERACTIONS AT 4.5 Bev (thesis). Jack Gordon Parks (Washington. Univ., Seattle). 1958. 44p.

Strips of G5 emulsion were exposed to a π^- beam produced by a 6.2-Bev proton beam incident on Be. The observed multiplicities of charged pions from π^- – N interac-

tions are compared with values obtained from the various theories (reviewed) of meson production. The angular dependence of the shower particles, mean free paths in the emulsion, multiplicities, and star size distributions from the experiment are compared with results of other experiments at and below 4.5 Bev. The multiple theory of meson production adequately describes the experimental results provided that meson creation is accompanied by a reabsorption mechanism. (D.C.W.)

36664 (UCRL-6989) PREPARATION OF SOME BACKED AND UNBACKED HEAVY-ELEMENT TARGETS. M. A. Williamson (California. Univ., Livermore. Lawrence Radiation Lab.). June 28, 1963. Contract W-7405-eng-48. 7p.

Thin (<10 mg/cm^2), self-supporting targets for L-shell fluorescence experiments were produced using the standard vacuum deposition method with some variations. Satisfactory targets of pure (unbacked) Dy, Sm, Pb, Bi, and Hf were produced. Holmium targets backed with Mylar, and Tb and Yb targets backed with Cu, were successfully produced. The vacuum deposition method normally uses, as a receiver for the deposited film, some material (usually glass) with a coating applied to it. Glass without a coating was used successfully for depositing the Tb, Yb, Pb, and Bi targets, thus eliminating a possible source of contamination to the target. Aluminum was used as a receiver for the Hf target and was later dissolved away with sodium hydroxide. (auth)

36665 (UCRL-7376) TRANSPORT COEFFICIENTS FOR THE SQUARE WELL POTENTIAL MODEL. S. G. Brush, and J. D. Lawrence (California. Univ., Livermore. Lawrence Radiation Lab.). June 1, 1963. Contract W-7405-eng-48. 26p.

The cross section integrals $\Omega^{(l,k)}$, related to the transport coefficient and previously given by Holleran and Hulburt, were recalculated. Values accurate to four significant figures are tabulated for (l,k) = (2,7),(1,5),(1,7),(1,9); d = 0,(0.1), and 0.9; and Q = 0,(0.1),(1.2),(0.2),2.0, 2.5, 3.0, and 4.0. Values disagreeing with corresponding Holleran and Hulburt values in the second significant figure are pointed out. (D.C.W.)

36666 (UCRL-10099(Rev.)) ANGULAR-MOMENTUM EFFECTS ON NEUTRON EMISSION BY Dy AND Tb COMPOUND NUCLEI. Gabriel N. Simonoff and John M. Alexander (California. Univ., Berkeley. Lawrence Radiation Lab.). Sept. 1962. Contract W-7405-eng-48. 36p.

Three reactions producing 4.1-hr Tb^{149} from Tb compound nuclei and nine reactions producing Dy products from Dy compound nuclei were studied as a function of energy. Incident particles were B^{10}, B^{11}, C^{12}, and O^{16} of energy 4 to 10.4 Mev amu. Measurements of the average recoil range give strong evidence that all these reactions proceed by compound-nucleus formation. From angular distribution data on the final heavy products for all these reactions the average total energies of photons and neutrons for each reaction were derived. In the Tb reactions the average total photon energy is always less than 12 Mev. In the Dy reactions the average total photon energy varies linearly with total available energy from nearly 0 to about 30 Mev. These large differences in total photon energy are attributed to differences in the angular momenta of the initial compound nuclei. The rate of increase of the average kinetic energy of all neutrons (from Dy systems) is approximately proportional to the square root of the excitation energy. For a given excitation energy of the Dy systems the average total photon energy does not appear to vary with average angular momentum. (auth)

36667 (UCRL-10484) DIRECT MEASUREMENT OF THE MAGNETIC MOMENT OF ERBIUM-169. Walter M. Doyle and Richard Marrus (California. Univ., Berkeley. Lawrence Radiation Lab.). Sept. 28, 1962. Contract W-7405-eng-48. 11p.

The hyperfine structure constant A and the magnetic moment for Er^{169} were measured by atomic beam magnetic resonance to be 725.46 and 0.513 nm. The magnetic moment was calculated to be 0.504 nm; the agreement with experiment seeming to verify Bleaney's idea that configuration admixing in rare earths is not appreciable. The least squares fitting of the data and the accuracy of the gyromagnetic constants determined by it are discussed; and frequencies calculated from A and these constants are compared with observed frequencies. (D.C.W.)

36668 (UCRL-10888) INTERNAL IONIZATION THAT FOLLOWS A REACTION BETWEEN COMPLEX NUCLEI. Naftali H. Steiger (California. Univ., Berkeley. Lawrence Radiation Lab.). June 26, 1963. Contract W-7405-eng-48. 28p.

The internal-ionization effect that follows a heavy ion-induced nuclear reaction was studied experimentally by magnetic analysis of the product atoms. The effect was investigated for the reaction $Pr^{141}(O^{16},8n)Ho^{149}$. Target thicknesses from 26.2 μg/cm^2 down to 9.7 μg/cm^2 were used. For target thicknesses lower than about 25 μg/cm^2, non-equilibrium ionic-charge spectra are obtained that tend toward lower probabilities for the charge states lower than the equilibrium mean charge, and tend toward higher probabilities for the charge states higher than the equilibrium mean charge. As a result, the mean ionic charge increases from 17.6 ± 0.5 for the equilibrium case to 19.4 ± 1.0 for a target thickness of 9.7 μg/cm^2. By extrapolation to target thickness zero, an ionic-charge spectrum is obtained which illustrates the "instantaneous internal ionization" obtained from the interaction between two complex nuclei. The shape of the extrapolated charge spectrum can be explained as being mainly composed of the two processes responsible for the internal ionization: the non-adiabatic part of the transition following a change in nuclear charge, and the development of vacancy cascades as a result of internal conversion. Based on experimental results, the part of the ionization that was caused by the first process was estimated to be somewhat less than 800 ev. (auth)

36669 (WASH-1042) REPORTS TO THE AEC NUCLEAR CROSS SECTIONS ADVISORY GROUP [AT] RICE UNIVERSITY, FEBRUARY 25, 1963. John R. Stehn (Brookhaven National Lab., Upton, N. Y.). Contract AT(30-2)-Gen-16. 44p.

Developments and preliminary data in the cross section measurement program are reported. Fission, reactions, scattering, resonances, polarizations, and equipment (spectrometers, choppers, etc.) are among the aspects covered. (D.C.W.)

36670 (AEC-tr-5955) QUASI-STATIC LIQUID-DROP MODEL OF NUCLEUS AS APPROXIMATION OF THE STATISTICAL MODEL. V. M. Strutinskii and A. S. Tyapin (Akademiya Nauk S.S.S.R. Ordena Lenina Institut Atomnoi Energii). Translated by Lydia Venters (Argonne National Lab., Ill.). 1963. 14p.

It is shown that the problem of determining the equilibrium distribution of nucleon density in the statistical model under conditions of low compressibility is reduced to a determination of the equilibrium form of some effective nuclear surface. Corrections for the liquid-drop model associated with a curved diffuse layer and finite compressibility were found. (auth)

36671 (AEC-tr-5976) A NEW TYPE OF RADIOACTIVITY. Irene Curie and F. Joliot. Translated by H. A. O'Brien, Jr. (Oak Ridge National Lab., Tenn.) from Compt. Rend., 198: 254(1934). 5p.

A number of light elements, irradiated with polonium α particles, continued to emit positrons for a definite period of time after removal of the source. The intensity of the extended radiation decreased exponentially with time with half lives of $3\frac{1}{4}$ min, $14\frac{1}{30}$ min, and 30 sec for Al, B, and Mg, respectively. The intensity immediately after irradiation also increased with irradiation time up to a limiting value. The positron of Al was determined to have an energy of 2.2 Mev, while that of B and Mg had an energy of 0.7 Mev. Reactions for the radioactivity are considered. (D.C.W.)

36672 DETERMINATION OF THE ELECTRIC NUCLEAR QUADRUPOLE MOMENTS OF BOTH ODD STABLE BARIUM ISOTOPES Ba^{135} AND Ba^{137}. Gisbert zu Putlitz (Universität, Heidelberg). Ann. Physik (7), 11: 248-60 (1963). (In German)

The hyperfine structure splitting of the 6 s 6 p P_1^3 term in the Ba I-spectrum of both odd stable Ba isotopes (both $I = \frac{3}{2}$) was investigated with the double resonance method. A method for the selective filling of individual hyperfine structure terms was tested. From the high frequency spectroscopically measured hyperfine structure splitting, the values $Q(Ba^{135}) = +0.18(2) \times 10^{-24}$ cm^2 and $Q(Ba^{137}) = +0.28(3) \times 10^{-24}$ cm^2 were determined for the electric nuclear quadrupole moments. The ratio of the quadrupole moments was $Q^{137}/Q^{135} = 1.537(2)$ and the hyperfine structure anomaly was $\Delta\epsilon = 2.1(6) \times 10^{-4}$. (tr-auth)

36673 INTERACTION OF VANADIUM WITH PROTONS OF ENERGIES UP TO 84 Mev. S. Hontzeas and L. Yaffe (McGill Univ., Montreal). Can. J. Chem., 41: 2194-2209 (Sept. 1963).

Radiochemical techniques were used to determine absolute excitation functions for 17 nuclides formed as spallation products from the irradiation of vanadium by protons of energy up to 84 Mev. The shape of the excitation functions and classical threshold calculations showed evidence of contribution of heavy-particle emission in the reactions of the type (p,3pxn), (p,5pxn), and (p,7pxn). The Barr method for analysis of the cross-section distribution was modified and applied at 60 and 80 Mev bombarding energies. The experimentally measured cross sections for 16 nuclides at 60 and 80 Mev bombarding energies were fitted to the four-parameter Rudstam equation $\sigma(A,Z) = \exp[PA - Q - R(Z - SA)^2]$. Comparison of the results obtained at 8-Mev bombarding energy with the predictions of the weak and strong absorption models showed better agreement with the predictions obtained by using the surface absorption Fernbach-Bjorklund potential. (auth)

36674 BACK-SCATTERING AND SELF-ABSORPTION OF β-PARTICLES. M. S. Lafleur, S. Kahana, T. F. Morris, and L. Yaffe (McGill Univ., Montreal). Can. J. Chem., 41: 2283-93(Sept. 1963).

The self-absorption of the β^--radiation from S^{35} and P^{32} was studied in various compounds. The function derived by Gora and Hickey was shown to fit the data. The back-scattering of the β^--radiation from P^{32} by various elements and compounds was examined and a semiempirical treatment used to suggest an effective atomic number for back-scattering by compounds. (auth)

36675 A REINVESTIGATION OF THE RANGE OF Na^{24} IONS OF KEV ENERGIES IN ALUMINUM. M. McCargo, F. Brown, and J. A. Davies (Atomic Energy of Canada Ltd., Chalk River, Ont.). Can. J. Chem., 41: 2309-13(Sept. 1963). (AECL-1795)

The range of Na^{24} in aluminum was reinvestigated in the energy region 1.0 to 100 kev, using an isotopically separated beam of Na^{24}. Below 10 kev, the results differed significantly from earlier data in which a much larger integrated flux of alkali metal ions ($Na^{23} + Na^{24}$) was required. Above 10 kev the discrepancy between the two sets of data disappeared. The theoretical treatment of Oen, Holmes, and Robinson was found to be in quite reasonable agreement with the median ranges ($\tilde{R}_m$) obtained, particularly if an allowance for the electronic stopping contribution at the higher energies is included. (auth)

36676 NEUTRON TOTAL CROSS SECTION OF ARSENIC AT 14 Mev. Y. C. Hsu, C. Y. Huang, P. K. Tseng, and Y. K. Tai (National Taiwan Univ., Taipei, China). Chinese J. Phys. (Taiwan), 1: 1-8(Apr. 1963).

Using the T (d,n) He^4 reaction as a monoenergetic source of neutrons of about 14 Mev the total cross section of arsenic was measured. For the production of neutrons a Zr-T target was bombarded by accelerating deuterons to 140 kev. Measurements were made with a good-geometry arrangement. The neutron detector used was a plastic scintillator of 1" × 1" ϕ. The neutron total cross section of arsenic at the neutron energy of 13.95 Mev was found to be 3.37 ± 0.04 barns. As a check the neutron total cross section of oxygen was also measured. (auth)

36677 $\bar{\nu}$: MEAN NUMBER OF NEUTRONS EMITTED PER FISSION OF U-238 INDUCED BY 14-Mev NEUTRONS. Lien-sheng Chuang and Ming-taw Lu (National Tsing Hua Univ., Hsin Chu, Taiwan, China). Chinese J. Phys. (Taiwan), 1: 9-13(Apr. 1963).

An attempt was made to determine $\bar{\nu}$, the mean number of neutrons produced per fission of U-238 induced by 14-Mev neutrons. The neutrons were supplied by a 3-Mev Van de Graaff accelerator using the reaction T (d,n) He^4. The fissile material was used in the form of U_3O_8. An experimental determination was made of the ratio of the number of neutrons detected in a given time with the fissile material in place surrounding the source and with the fissile material removed. A manganese bath containing manganese sulfate was used as a neutron detector for this purpose. The value 4.36 ± 0.34 neutrons per fission was obtained. (auth)

36678 NEW SCHEME FOR CALCULATING NUCLEAR RADII. Jenn-lin Hwang (National Taiwan Univ., Taipei, China). Chinese J. Phys. (Taiwan), 1: 24-5(Apr. 1963).

It is pointed out that the nuclear radius is a function not of the mass number alone, but rather of neutron number and proton number. A convenient interpolation scheme for calculating nuclear radii is proposed. (auth)

36679 GREEN'S INDEPENDENT PARTICLE MODEL AND NUCLEAR SIZE. Jenn-lin Hwang and Shin-hin Yee (National Taiwan Univ., Taipei, China). Chinese J. Phys. (Taiwan), 1: 28-9(Apr. 1963).

The nuclear radii of magic and near-magic nuclei are calculated in the Green independent-particle model, and the calculated values are compared with predictions of an empirical equation based on a certain number progression. (T.F.H.)

36680 THE QUENCHING OF POSITRONIUM AND THE INHIBITION OF ITS FORMATION IN AQUEOUS AND ORGANIC SOLUTIONS. V. I. Gol'danskiĭ, T. A. Solonenko, and V. P. Shantarovich (Inst. of Chemical Physics, Academy of Sciences, USSR). Dokl. Akad. Nauk SSSR, 151: 608-11 (July 11, 1963). (In Russian)

Determination of the time characteristics of the decay of positrons in liquids and solids is widely used for the study of positronium atoms. The short-lived ($\tau_1 = 10^{-10}$ sec) para-positronium and the long-lived ($\tau_2 = 10^{-9}$ sec) are present statistically in a ratio of 3 : 1. Annihilation processes characterized by the life time of τ_2 are designated as I_2, giving a probability of formation of the positronium equal to $\frac{4}{3} I_2$. External factors, such as temperature, pressure, or composition changes affect the quenching and the inhibition of the formation of the positronium. The quenching process may be due to the conversion of the ortho-positronium into free, unpaired electrons forming a short-lived singlet, to the "pick-up" annihilation of a positron entering an atom, or to oxidation-reduction type reactions. The problem was studied by determining the effect of NO_3^-, CrO_4^{2-}, $Cr_2O_7^{2-}$, and MnO_4^- added to aqueous solutions and of C_6H_5I additions to benzene on the basic characteristics of the long-lived component. Na^{22} was used as the positron source in the experiments, carried out with scintillation counters. The results showed that the nitrate ion exerts a complete inhibiting effect while the other anions effectively quench the positronium, reducing the value of τ_2 but do not inhibit its formation. The addition of C_6H_5I to benzene had a more complex inhibiting effect. (TTT)

36681 SPALLATION YIELDS FROM IRON WITH 24 Gev PROTONS. Peder J. Estrup (CERN, Geneva). Geochim. Cosmochim. Acta, 27: 891-5(Aug. 1963).

The spallation of iron with 24-Bev protons was studied using radiochemical techniques. Formation cross sections are reported for 24 nuclides with half lives ranging from a few hours to a few years. The spallation systematics and the excitation functions are discussed in relation to cosmic-ray-induced transformations. (auth)

36682 BETA DECAY OF Λ HYPERONS AND SPINS OF LIGHT HYPERNUCLEI. V. A. Filimonov (Tomsk Polytechnic Inst., USSR). Izv. Vysshikh Uchebn. Zavedenii, Fiz., No. 3, 89-97(1963). (In Russian)

The beta decays ${}_\Lambda H^3 \rightarrow He^3 + e^- + \tilde{\nu}$ and ${}_\Lambda H^4 \rightarrow He^4 + e^- + \tilde{\nu}$ were investigated on the basis of Lee-Yang four-fermion interactions. Decay characteristics were analyzed as functions of hypernucleus spins. The shapes of electron spectra are not a function of hyperon spin or interaction constants, while the shapes of nuclear recoil, spectra are definitely a function of these magnitudes. Various combination constants were obtained for light hypernucleus β decay, and a method for their determination was developed. (tr-auth)

36683 A VARIATION-PERTURBATION APPROACH TO THE INTERACTION OF RADIATION WITH ATOMS AND MOLECULES. M. Karplus and H. J. Kolker (Columbia Univ., New York). J. Chem. Phys., 39: 1493-1506 (Sept. 15, 1963).

A variation-perturbation formulation for time-dependent interactions is presented and applied to the interaction between atoms or molecules and a semiclassical radiation field. Details of the treatment through second order are given for the steady-state problem and are compared with the standard perturbation-theory results. It is demonstrated that the usual expression for the time-dependent perturbation solution, which consists of a sum over an infinite set of excited states (including any continuum), can be replaced by a small number of frequency-dependent functions that satisfy certain time-independent differential equations. Since an exact solution to these equations is very difficult for all but the simplest cases, an equivalent variational formulation of more general utility is introduced. The induced time-dependent electric and magnetic moments of atoms and molecules in an oscillating electromagnetic field are evaluated in terms of the frequency-dependent functions. With the usual continuum medium assumptions, the macroscopic polarizations are determined from these moments, and simple formulas for the index of refraction and optical rotatory power are obtained. The method is illustrated by a simple application to the dynamic polarizability of the harmonic oscillator and by a more detailed examination of the dynamic polarizability and index of refraction of the nonrelativistic hydrogen atom. A comparison is made between an exact solution and a variational approximation for this problem. The excellent agreement between the two methods provides an indication of the power of the variational formulation. An indication of its utility for more general applications is given. (auth)

36684 ANGULAR DISTRIBUTIONS FOR A RANGE OF Q-VALUES IN THE REACTION $F^{19}(d,p)F^{20}$. V. M. Rout, W. M. Jones, and D. G. Waters (Associated Electrical Industries Ltd., Aldermaston, Berks, Eng.). Nucl. Phys., 45: 369-82(Aug. 1963).

Analysis of the angular distributions of 21 proton groups from the reaction $F^{19}(d,p)F^{20}$, up to an excitation energy of 4.3 Mev with a deuteron energy of 2 Mev has yielded several new values of l_n and modified other values of l_n obtained previously. (auth)

36685 ANGULAR DISTRIBUTIONS OF STRIPPING REACTIONS ON SILICON 29 AND OXYGEN 17. E. El-Baz (Institut de Physique Nucleaire, Lyon). Nucl. Phys., 45: 383-91(Aug. 1963). (In French)

Using plane waves in the incoming and the outgoing channels and a complementary interaction (interaction of the emerging proton with the residual nucleus) without spin-orbit coupling, calculation of angular distribution can fit experimental points at large angles. Applications are made for the $Si^{29}(d,p)Si^{30}$ and $O^{17}(d,p)O^{18}$ reactions. It is shown that this method is unable to explain polarization of the emerging protons. (auth)

36686 ANGULAR DISTRIBUTION OF THE CIRCULARLY POLARIZED GAMMA RAYS FOLLOWING THE FIRST-FORBIDDEN BETA DECAYS OF Rb^{84} AND Rb^{86}. F. Boehm (California Inst. of Tech., Pasadena) and John D. Rogers. Nucl. Phys., 45: 392-400(Aug. 1963). (In English)

Two first-forbidden beta decays followed by gamma rays in the spin sequence $2^- \rightarrow 2^+ \rightarrow 0^+$ were studied with the help of the circular polarization correlation technique. From the observed angular distribution the following results are derived in the case of Rb^{84}: $W(\vartheta) = 1 + [(0.115 \pm 0.045)P_1(\cos\vartheta) + (0.125 \pm 0.065)P_3(\cos\vartheta)]\nu/c$, in the case of Rb^{86}: $W(\vartheta) = 1 + [(0.185 \pm 0.048)P_1(\cos\vartheta) - (0.283 \pm 0.066)P_3(\cos\vartheta)]\{1 + \bar{\epsilon}P_2(\cos\vartheta)\}\nu/c$, where $\bar{\epsilon} \approx 0.16$ is the anisotropy of the beta-gamma correlation for an average energy of 400 kev. The presence of the large P_3 terms in both cases can only be understood in terms of a large tensor matrix-element B_{ij}. It is shown, however, that the modified B_{ij} approximation is not sufficient to describe the experimental results. A detailed analysis gives the following matrix elements in Kotani's notation, in the case of Rb^{84}, $x = -0.07$, $u = -0.30$, $w = -0.35$, $Y = -1.55$, $V = -1.05$, when $z = +1.0$; and in the case of Rb^{86}, $x = -0.14$, $u = -0.30$, $w = -0.12$, $Y = -0.47$, $V = -0.40$, when $z = +1.0$. (auth)

36687 VACUUM POLARIZATION INDUCED BY THE NUCLEAR QUADRUPOLE MOMENT IN Mu-MESONIC ATOMS. J. M. Pearson (Universite, Montreal and National Research Council, Ottawa). Nucl. Phys., 45: 401-4(Aug. 1963). (In English)

The vacuum polarization potential induced by the quadru-

pole moment of a deformed nucleus is calculated. An estimate is made of its effect on the quadrupole splitting of the energy levels of μ-mesonic atoms with deformed nuclei. It is found that for the most strongly affected level, the 2p level, the quadrupole interaction parameter is increased by approximately $\frac{1}{2}\%$ by the vacuum polarization contribution. (auth)

36688 DEPENDENCE OF THE CIRCULAR POLARIZATION OF EXTERNAL BREMSSTRAHLUNG ON ATOMIC NUMBER. A. Bisi, A. Fasana, and L. Zappa (Instituto di Fisica del Politecnico, Milan). Nucl. Phys., 45: 405-9 (Aug. 1963). (In English)

The degree of the circular polarization of external bremsstrahlung from beta rays of P^{32} (E_{max} = 1.72 Mev) in thick targets was measured as a function of target atomic number. A dependence was found between the polarization P and the atomic number Z, for instance a decrease of EB circular polarization of about 25% occurs when an Al target is replaced by a Pb target. In deriving this dependence the contribution of the internal bremsstrahlung was taken into account, by extending the polarization measurements down to very low Z values (Z = 2.7, i.e, polyethylene). (auth)

36689 DECAY OF AN ISOMERIC STATE IN Cm^{244}. P. G. Hansen (Research Establishment, Risø, Denmark), K. Wilsky, C. V. K. Baba, and S. E. Vandenbosch. Nucl. Phys., 45: 410-16(Aug. 1963). In English)

The 1042-kev state in Cm^{244}, which is populated in the β decay of 10.1-hv Am^{244}, has previously been assigned $(K,I\pi) = (6,6^+)$. This assignment has now been confirmed through an angular correlation measurement, and it was found that the 746-kev γ ray is a mixture of 46% quadrupole (E2) and 54% dipole (M1). The half life of the 1042-kev state was determined by measurement of delayed coincidences between β particles and conversion electrons. The result is 34 ± 2 ms. Comparison with the single particle estimate shows that the E2 transitions from the delayed state are hindered by factors of about 10^{10}. This reflects the fact that the transitions are four times forbidden in K. The relative transition probabilities for the E2's from the delayed state are shown to agree well with a recent theoretical estimate. (auth)

36690 DECAY OF AN ISOMERIC STATE IN U^{234}. P. G. Hansen (Research Establishment, Risø, Denmark), K. Wilsky, and S. Bjoernholm. Nucl. Phys., 45: 417-22(Aug. 1963). (In English)

The half life of an isomeric state in U^{234} was measured by time analyzer techniques to be 33.5 ± 2.0 μs. The γ spectrum of the isomer was studied by delayed coincidence techniques, and energies and intensities are presented. The findings confirm the following main features of the decay scheme: (1) The isomer is fed through a 126 kev γ ray; (2) The isomer depopulates through states of the γ-vibrational band in U^{234}. Many details of the decay, however, are not yet clear. (auth)

36691 THE COULOMB ENERGIES OF THE LOWER EXCITED LEVELS IN THE LIGHT NUCLEI. W. M. Fairbairn (Manchester College of Science and Tech., Eng.). Nucl. Phys., 45: 437-42(Aug. 1963). (In English)

The Coulomb energy differences of the lower excited levels in the mirror nuclei with $5 \leqq A \leqq 17$ are calculated using first-order perturbation theory and shell model representations for the nuclear states. The Slater integrals for the Coulomb potential are used as parameters in the calculation and the nuclear radius is assumed to vary as $A^{\frac{1}{3}}$. Good agreement is found with the experimental values when account is taken of other effects, such as the Thomas-Ehrman shift, which will contribute to the differences in the energy level spectra of a mirror pair. (auth)

36692 LEVELS OF N^{13} NEAR 7 Mev EXCITATION. PART I. F. C. Barker, G. D. Symons, N. W. Tanner, and P. B. Treacy (Australian National Univ., Canberra). Nucl. Phys., 45: 449-66(Aug. 1963). (In English)

Excitation functions and angular distributions of protons inelastically scattered by carbon were measured for beam energies between 5.2 and 6.6 Mev in order to give information on the levels of N^{13} near 7-Mev excitation. An analysis is made of these data, together with previously measured angular distributions of the 4.43-Mev γ rays emitted following the inelastic scattering. Good agreement with these results can be obtained by assuming contributions from a small number of interfering levels of N^{13}. Levels at 7.16 and 7.38 Mev are found to have spins and parities $\frac{7}{2}^+$ and $\frac{5}{2}^-$ or $\frac{7}{2}^-$, respectively, which differ from assignments previously accepted. Partial widths are obtained for these levels and for the $\frac{3}{2}^+$ level at 6.88 Mev. The $\frac{5}{2}^+$ level at 6.38 Mev gives important contributions to the inelastic scattering cross section in the region studied, and small but significant contributions can come from the $\frac{1}{2}^-$ ground state and the $\frac{3}{2}^-$ level at 3.51 Mev. (auth)

36693 LEVELS OF N^{13} NEAR 7 Mev EXCITATION. PART II. F. C. Barker (Australian National Univ., Canberra). Nucl. Phys., 45: 467-72(Aug. 1963). (In English)

An intermediate coupling shell model calculation, with interaction parameters chosen to fit level energies in N^{14}, predicts a $\frac{5}{2}^-$ level of N^{13} near 7 Mev. This suggests that the 7.42-Mev level of N^{13}, found previously to be $\frac{5}{2}^-$ or $\frac{7}{2}^-$, is actually $\frac{5}{2}^-$. The measured reduced widths of this and other low-lying levels of N^{13} are in reasonable agreement with those obtained from shell model calculations. (auth)

36694 ELASTIC SCATTERING OF RELATIVISTIC ELECTRONS BY SCREENED ATOMIC NUCLEI. Shin-R Lin (Univ. of Michigan, Ann Arbor), Noah Sherman, and Jerome K. Percus. Nucl. Phys., 45: 492-504(Aug. 1963). (In English)

The effect of screening by atomic electrons on the scattering of relativistic electrons by heavy atoms was computed numerically using different screening models. Exponential and Hartree potentials were used to simulate the screening. The asymmetry factor $S(\theta)$ and the differential scattering cross section $d\sigma(\theta)/d\Omega$ were computed at 15 degree intervals from 15° to 165°. The results for (a) 121-kev electrons scattered by gold, Z = 79, using two exponential potentials of different range, (b) 79-kev (ν/c = 0.5) electrons scattered by mercury, Z = 80, using exponential and Hartree fields, (c) 46-kev (ν/c = 0.4) electrons scattered by mercury as in (b) are given. The asymmetry factor $S(\theta)$ and $d\sigma/d\Omega(\theta)$ were computed using a partial wave expansion in which the phase shifts were obtained both by numerical integration of a suitably transformed Dirac radial equation and also computed in WKB approximation. The results are compared with corresponding calculations for the Coulomb field. In general the differences are no more than a few percent, but below 30° the screened field cross-sections are as much as 50% smaller. (auth)

36695 BRUECKNER'S CHARGE DENSITY AND ELECTRON SCATTERING CROSS SECTIONS. R. J. Kulkarni and N. V. V. J. Swamy (Karnatak Univ., Dharwar, India). Nucl. Phys., 45: 513-16(Aug. 1963). (In English)

Estimates of electron scattering cross sections were made using the Brueckner charge density in Ca^{40}, in the first Born approximation. For comparison, Fermi uniform and harmonic oscillator models were also used. The

Brueckner density does not give as good a fit as the other two charge distributions because of a rather small rms radius. (auth)

36696 THE ELASTIC SCATTERING OF DEUTERONS BY CARBON. G. G. Ohlsen and R. E. Shamu (Australian National Univ., Canberra). Nucl. Phys., 45: 523-8(Aug. 1963). (In English)

The angular distribution of deuterons elastically scattered from carbon was measured in about 5° steps at eight energies between 6.0 and 11.8-Mev deuteron energy. In addition, the $C^{12}(d,d)C^{12}$ excitation function at a laboratory angle of 165° was measured in about 50-kev steps from 3.05 to 11.95 Mev. The shape of the angular distribution is observed to change appreciably for energy differences of 1 Mev or less. (auth)

36697 ON THE QUESTION OF THE EXISTENCE OF LONG-LIVED NUCLEAR ISOMERS OF Os^{187} AND Os^{188}. E. Merz (Kernforschungsanlage, Julich, Ger.). Nukleonik, 5: 223-5(Aug. 1963). (In German)

The existence of long-lived isomers of Os^{187} and Os^{188} was investigated. Reactions of the types (n,γ); (n,2n); (n,n'); (d,n); (d,2n); (d,p); and (γ,γ) on Os^{187} were investigated for the production of the isomers of Os^{186}, Os^{187}, and Os^{188}. All of these investigations gave negative results and it was concluded that the long-lived isomers do not exist. (tr-auth)

36698 $Be^9(Li^7,Li^8)Be^8$ REACTION IN A COULOMB-DISTORTED WAVE APPROXIMATION. Charles W. Lewis (Univ. of Minnesota, Minneapolis). Phys. Rev., 131: 2590-3(Sept. 15, 1963).

The angular distributions of the $Be^9(Li^7,Li^8)Be^8$ reaction, measured between 2 and 4 Mev by Norbeck et al., are compared with a theory for the differential cross section, which was derived for (d,p) reactions at low bombarding energies on heavy nuclei and trivially modified to apply to the reaction under consideration. The theory uses Coulomb wave functions to describe the relative motion in the initial and final states of the system. The only parameter is a normalization constant which is determined by comparison with experiment at one energy. The theory is in good agreement with experiment at forward angles, and it is suggested that refinements in experimental technique may cause better agreement at back angles. Results for the classical theory of the reaction as given by Allison are also presented for comparison. (auth)

36699 ANGULAR CORRELATION IN THE $B^{11}(d,n\gamma_{15.11Mev})C^{12}$ REACTION. H. J. Kim and E. F. Shrader (Case Inst. of Tech., Cleveland). Phys. Rev., 131: 2594-7(Sept. 15, 1963).

Distorted-wave effects in stripping reactions may be more apparent in the analysis of nucleon-γ-ray angular correlation than in the angular distribution of the stripped nucleon. The reaction $B^{11}(d,n\gamma_{15.11Mev})C^{12}$ was used to study the distortion effect, since the angular distribution of neutrons feeding 15.11-Mev 1(+) state shows remarkably good agreement with the Butler stripping pattern. The angular distribution of other neutron groups of the reaction $B^{11}(d,n)C^{12}$ cannot be fitted satisfactorily by Butler approximation. The neutrons feeding the 1(+) 15.11-Mev state of C^{12} as determined by a time-of-flight technique were detected in coincidence with the 15.11-Mev de-excitation γ ray emitted in direction of 10° and 90° relative to the incident deuterons at deuteron energies of 2.59 and 2.29 Mev. The result of the n-γ correlation shows marked departure from the plane-wave, Butler theory. (auth)

36700 DECAY OF Pt^{197}. R. G. Helmer (Phillips Petroleum Co., Idaho Falls, Idaho). Phys. Rev., 131: 2597-2601(Sept. 15, 1963).

The decay of Pt^{197}_{78} (20 h) to Au^{197}_{79} was studied by means of gamma-ray scintillation spectrometry. Three gamma-ray transitions of 77, 191, and 269 kev exist. The energy of the third transition was found to be (269.2 ± 0.5) kev, instead of the previously reported value of 279 kev. A new decay scheme is proposed with only two excited states, at 77 and 269 kev. The possible effects of these results on the interpretation of measurements of the Coulomb excitation of Au^{197} and of the decay of Hg^{197} are discussed. (auth)

36701 POLARIZATION OF 40-Mev PROTONS BY COMPLEX NUCLEI. C. F. Hwang, G. Clausnitzer, D. H. Nordby, S. Suwa, and J. H. Williams (Univ. of Minnesota, Minneapolis). Phys. Rev., 131: 2602-10(Sept. 15, 1963).

The polarization of 40-Mev protons scattered by helium, lithium, carbon, aluminum, nickel, and lead was measured using a polarized proton ion source in conjunction with the Minnesota Proton Linear Accelerator. Experimental procedures utilized in the measurements are discussed in detail. p-α polarization measurements are compared with the theoretical predictions by Gammel and Thaler. (auth)

36702 BETA-GAMMA DIRECTIONAL CORRELATION IN La^{140}. S. K. Bhattacherjee and S. K. Mitra (Tata Inst. of Fundamental Research, Bombay). Phys. Rev., 131: 2611-15(Sept. 15, 1963).

The directional correlation between the nonunique first-forbidden outer beta group of end-point energy 2.175-Mev in La^{140} and the 1.6-Mev cascade gamma ray in Ce^{140} was measured at nine beta energies. The measured beta-gamma correlation coefficient ϵ ranges from (0.080 ± 0.010) to (0.111 ± 0.020) in the beta-energy interval 1.6 to 2 Mev. Taking account of the existing data on shape correction factor and also the beta-gamma circular polarization coefficient ω for $\theta = 160°$ and $W = 4.2$, the relevant first-forbidden beta-decay matrix-element ratios have been extracted; the ratios of the matrix elements are (in Kotani's notation) $x = -0.33 \pm 0.15$, $u = -0.06 \pm 0.06$, and $Y = -1.50 \pm 0.20$. Absolute values of the matrix elements were obtained from the observed ft value as $|\int B_{ij}|/R = (3.3 \pm 0.5) \times 10^{-2}$, $|\int r|/R = (1.3 \pm 0.6) \times 10^{-2}$, $|\int i\sigma \times r|/R = (0.2 \pm 0.2) \times 10^{-2}$, $|\int i\alpha| = (4.3 \pm 1.5) \times 10^{-3}$. A cancellation among the vector-type matrix elements is apparently the cause of the deviation from the ξ approximation in this case. (auth)

36703 OCTUPOLE DEFORMATION IN EVEN-EVEN MEDIUM MASS NUCLEI. M. L. Rustgi and S. N. Mukherjee (Banaras Hindu Univ., Varanasi, India). Phys. Rev., 131: 2615-16(Sept. 15, 1963).

The stability of octupole deformation for even-even medium mass nuclei with small spheroidal deformation was studied in order to explain the existence of odd-parity excited states in some of them. The total single-particle energy is calculated by an exact diagonalization of the Nilsson Hamiltonian with octupole deformation, neglecting the residual two-particle interaction. Within this framework, it is found that these nuclei are stable against octupole deformation. (auth)

36704 MASS AND ENERGY DISTRIBUTIONS IN THE SPONTANEOUS FISSION OF SOME HEAVY ISOTOPES. Reinhard Brandt, Stanley G. Thompson, Raymond C. Gatti, and Llad Phillips (Univ. of California, Berkeley). Phys. Rev., 131: 2617-24(Sept. 15, 1963). (UCRL-10506)

A back-to-back semiconductor counter system was used to study the energy and mass distributions of the fission fragments in the spontaneous fission of the isotopes, Fm^{254}, E^{253}, Cf^{254}, and Cm^{248}. The results are compared to the fission fragments produced by the spontaneous fission of

Cf^{253}, whose fission properties are well known. All distributions (including those of the odd-mass isotope E^{253}) are rather similar, but not identical with the standard Cf^{252}. The mean prompt kinetic energy of the frgaments increases with Z, and this trend is compared with the results of other related experiments. The asymmetry of the mass distributions shows only small differences between the isotopes studied here. Some theoretical aspects of the asymmetries are discussed. The variance (widths) of nearly all the distributions increases with Z and seems to increase with A. A new semiempirical correlation between the variances and Z^2/A is proposed and interpreted on a qualitative basis. The effects of neutron emission on the results are briefly discussed and the values of the mean total kinetic energy release are corrected for the effect of neutron emission. (auth)

36705 DECAY OF Cs^{134} AND THE LEVEL SCHEME OF Ba^{134}. P. N. Trehan, John D. French, and Max Goodrich (Louisiana State Univ., Baton Rouge). Phys. Rev., 131: 2625-31(Sept. 15, 1963).

The energy (in kev) and the relative intensity of the gamma rays following the decay of Cs^{134} have been measured as 475(1.1), 563(9), 569(11), 605(98), 800(93), 1038(1.1), 1168(2.7), and 1367(3.5) with the help of the various scintillation spectrometry techniques. No gamma rays of energy 960, 1570, 1640, 1770, and 1970 kev reported earlier by certain workers could be detected. In addition to the already established 86 kev (26%) and 655 kev (71%) end-point beta rays, three beta rays of end points and intensities 1453 kev (0.13%), 892 kev (0.7%), 410 kev (2.1%) were confirmed by careful measurement with the help of a beta-ray spectrometer. The K-conversion coefficient of the gamma rays and the log ft value of the beta rays were obtained. The measurements established more firmly the decay scheme including the spin and parity assignments to the various levels. (auth)

36706 ENERGY SPECTRUM OF ATOMIC ELECTRONS EJECTED IN ELECTRON-CAPTURE DECAY OF Fe^{55}. J. G. Pengra and B. Crasemann (Univ. of Oregon, Eugene). Phys. Rev., 131: 2642-8(Sept. 15, 1963).

The shape of the energy spectrum of orbital electrons ejected from Fe^{55} during nuclear decay by electron capture was measured from 28 to 190 kev (the theoretical end point is at 218 kev). The electrons were detected in a proportional counter or in a semiconductor particle detector, in coincidence with Mn K x rays. The electron ejection probability decreases by a factor of 10^3 over the investigated energy range. The shape of the measured spectrum differs somewhat from theoretical predictions, in that the ejection probability falls off more slowly with energy. The discrepancy becomes more pronounced with decreasing energy. The contributions of L-electron ejection are considered. (auth)

36707 RARE NUCLEAR REACTIONS INDUCED BY 14.7-Mev NEUTRONS. E. T. Bramlitt and R. W. Fink (Univ. of Arkansas, Fayetteville). Phys. Rev., 131: 2649-63(Sept. 15, 1963). (TID-19037)

Activation cross sections for 14.7 ± 0.2-Mev neutrons were measured for [(n,nα) + (n,αn)] reactions with Cu^{65}, Zn^{70}, Ga^{71}, and Nb^{93}, while upper limits were set for this reaction for V^{51}, Ge^{76}, Br^{81}, Rb^{87}, Ag^{107}, Ag^{109}, In^{115}, Au^{197}, and Tl^{203}. Cross-section limits also were set for (n,2p) reactions on Si^{29}, K^{41}, Sc^{45}, Ti^{50}, V^{51}, Mn^{55}, As^{75}, Y^{89}, Nb^{93}, Cs^{133}, La^{139}, Pr^{141}, and Tb^{159}; and for (n,He^3) reactions on Sc^{45}, Nb^{93}, Au^{197}, and Tl^{205}. Cross sections were determined for (n,γ) reactions on Y^{89}, Nb^{93}, and Pr^{141}, and upper limits were set for (n,3n) reactions with Pr^{141}, Au^{197}, and Tl^{203}. The [(n,np) + (n,np)] reaction was detected with Ni^{58}, but not with Mo^{92}. A value of 520 ± 120 mb was established for the former, and an upper limit set for the latter. Absolute disintegration rates were obtained by both beta and gamma spectroscopy counting methods. Extensive use of radiochemical separation was made in order to isolate the low-yield rare reaction products from large target samples. Statistical theory was employed (using parameters selected from a critical analysis of the literature) to make theoretical cross section estimates for many of the reactions studied. The theoretical cross sections for (n,αn) reactions agree remarkably well with the experimentally determined [(n,nα) + (n,αn)] cross section sums, thereby suggesting that the path for this reaction may be predominantly the (n,αn) process. For certain cases, statistical theory predicts appreciable (n,2p) cross sections at 14.7 Mev; e.g., for Cr^{50}, Ni^{58}, Kr^{78}, and Mo^{92}. It is suggested that in studies of emitted proton spectra which show an excess of low-energy protons, a contribution may be present from the (n,2p) as well as the (n,np) reaction. A new gamma at 176 ± 4 kev in about 5% of 1.8-day Sc^{48} decays is confirmed. (auth)

36708 QUANTITATIVE NUCLEAR EVAPORATION THEORY AND THE NUCLEAR POTENTIAL. David B. Beard and Alden McLellan (Univ. of California, Davis). Phys. Rev., 131: 2664-74(Sept. 15, 1963).

The energy level densities of nucleons in a diffuse nuclear well are calculated using an Eckart-Bethe (Woods-Saxon) potential and shown to be a more sensitive function of energy than the calculated densities of nucleons in a square well having the same volume. The particle spectra of 16-Mev (p,n) reactions and 14-Mev inelastically scattered neutrons are computed including multiple neutron emission. Using realistic values for the effective nucleon mass, the nuclear radius, and the diffuseness parameters, the theoretical spectra fit the experimentally observed spectra well within the experimental error. This fit is obtained without the usual experimental parameter fitting of theoretically undetermined constants. Methods of obtaining single-particle emission spectra from experimentally determined particle spectra when multiple-particle emission occurs are discussed. It is suggested that a careful analysis of precisely measured evaporation spectra will give some information about the dependence of the diffuseness of the nuclear potential on excitation energy. (auth)

36709 ANALYSIS OF ELECTRON-He^3 SCATTERING. J. S. Levinger (Cornell Univ., Ithaca, N. Y.). Phys. Rev., 131: 2710-12(Sept. 15, 1963).

Measurements of elastic electron-He^3 scattering show that the magnetic form factor F_M decreases less rapidly with q^2 than the electric form factor F_E in the range $0 \leq q^2 \leq 5\ F^{-2}$. The difference is interpreted as due to the effect of the exchange magnetic moment of He^3, which should have a spatial extension appreciably smaller than that of the probability density. Assuming that the static exchange moment is -0.27 nm, we determine the shape of the form factor F_x of this moment from $F_M(q^2)$ and $F_E(q^2)$. $F_x(q^2)$ can be fitted with the expression $1-(0.1 \pm 0.02)q^2$. The model gives explicit predictions for the form factors in electron-H^3 scattering. (auth)

36710 ON THE THEORY OF ROTATIONAL STATES OF ODD NUCLEI WITH WEAK NON-AXIALITY. Sh. Sharipov. Vestn. Mosk. Univ., Ser. III, Fiz. Astron., No. 1, 38-42(Jan.-Feb. 1963). (In Russian)

Energy spectra of excited odd nuclei with ground state spins of $^5/_2$ and $^7/_2$ were calculated as functions of the rota-

tional energy relation to the external nucleon bonding with the non-spherical part of the nuclear core. (tr-auth)

36711 ON THE THEORY OF ISOTOPIC SHIFTS. N. N. Kolesnikov and Yu. P. Grigor'ev. Vestn. Mosk. Univ., Ser. III, Fiz. Astron., No. 3, 32-43(May-June 1963). (In Russian)

A precise relativistic formula, considering electron wave distortions, was developed for calculating electron shift levels ($nj = l \pm \frac{1}{2}$) appearing with finite-dimension nuclei at arbitrary spherically-symmetric nucleon densities that break away at a finite point. The results were generalized for the case of spherically asymmetric nucleons that do not break away at finite distances. (tr-auth)

36712 STUDIES OF THE LOW-LYING ENERGY LEVELS OF Zn^{64} AND Zn^{66} FROM MEASUREMENTS OF $(p,p'\gamma)$ RADIATIONS. A. K. Sen Gupta and D. M. Van Patter (Franklin Inst., Swarthmore, Penna.). 40p. (CONF-46-94)

From American Physical Society 1963 Spring Meeting, Washington, D. C., Apr. 1963.

An experimental investigation of the $(p,p'\gamma)$ radiations from semi-thick targets of Zn^{64}(2.4 mg/cm^2) and Zn^{66}(2.7 mg/cm^2) is carried out. Angular distributions of the $(p,p'\gamma)$ radiations and the excitation cross-sections are measured for proton energies ranging from 4.42 to 5.02 Mev. These results are compared with theoretical predictions using statistical reaction theory and optical model penetrabilities. Agreement is obtained for the angular distribution measurements, and level spins are assigned on this basis. The measured cross sections, however, show some disagreement with theoretical values, which are particularly pronounced for the first 2+ states in both Zn^{64} and Zn^{66}. The studies of the stronger γ rays suggest the following levels and the spins and parities: Zn^{64} – 0.993(2+), 1.804(2+), 1.904(0+), 2.321(4+), and 2.618(0+); Zn^{66} – 1.037(2+), 1.865(2+), 2.383(0+), and 2.462(4+?) Mev. Some additional weaker γ rays are also observed in both the isotopes. The collective nature of the first 2+ states in Zn^{64} and Zn^{66} being known, the (2,0,4) triplets that are seen in both these isotopes (at an energy roughly twice that of the first 2+ states) suggest that some kind of vibrational motion could account for these low-lying excited states. (auth)

36713 ON LIPKIN'S TREATMENT OF PAIRING FORCES IN NUCLEI. Yukihisa Nogami (National Research Council, Ottawa). 5p. (CONF-46-15)

From American Physical Society Meeting, Washington, D. C., Apr. 1963.

The BCS method can be used to obtain approximate wave functions for nuclei. Lipkin suggested the model hamiltonian $\mathcal{H} = H - f(n)$ for use in investigating any variations of this BCS method in which effects of fluctuation of the number of nucleons would be eliminated. Some features of Lipkin's method are discussed, and the method is applied to a simple case where N identical nucleons are in the configuration $(j)^N$. Although the model is unrealistic, some interesting possibilities for realistic cases are considered. (A.G.W.)

36714 INELASTIC SCATTERING OF PROTONS BY Cr^{50}. G. C. Kyker, Jr., E. G. Bilpuch, and H. W. Newson (Duke Univ., Durham, N. C.). 11p. (CONF-46-16)

From American Physical Society Meeting, Washington, D. C., Apr. 1963.

The proton beam from the Duke University 3-Mev Van de Graaff and a target of 99% enriched Cr^{50} were used to measure level spacings in the resonance inelastic scattering of protons by Cr^{50}. The yield of the reaction $Cr^{50}(p,p_1)Cr^{50}$ + 0.78-Mev γ is shown from 2.15 to 2.85 Mev at an angle of 130°. In this energy span, 53 resonances were observed. Angular distributions of the γ yield were studied on most of the resonances. There was a small but definite yield between resonances. Level spacing values of 47 ± 13 kev for $\frac{3}{2}^+$ levels and 39 ± 10 kev for $\frac{5}{2}^+$ levels were obtained. The S-wave level spacing that should be observed in the Cr^{50} neutron cross section is predicted to be 17 ± 4 kev. (A.G.W.)

36715 EFFECT OF STATIC QUADRUPOLE INTERACTION ON $\gamma\gamma$ DELAYED ANGULAR CORRELATION IN Ta^{181}. R. W. Sommerfeldt and L. Schecter (Oregon State Univ., Corvallis). 7p. (CONF-46-9)

From American Physical Society Meeting, Washington, D. C., Apr. 1963.

The effect of a static quadrupole interaction on the angular correlation of the 133,482-kv γ cascade in Ta^{181} was studied. A source of polycrystalline Hf metal containing the activity was used. The differential anisotropy was measured as a function of the time interval between the formation and decay of the intermediate level by the method of delayed coincidence. The results display the general periodic features predicted by theory and allow the determination of the quadrupole coupling through the observation of the quadrupole precession period. (A.G.W.)

36716 THE MEASUREMENT OF THE POLARIZATION OF PROTONS FROM DEUTERON STRIPPING REACTIONS. Larry Hylton Reber. Thesis, Pittsburgh, University of Pittsburgh, 1963. 161p. (CONF-46-25)

From American Physical Society Spring Meeting, Washington, D. C., Apr. 1963.

The University of Pittsburgh cyclotron and scattering system were used to investigate the angular distributions of the proton polarization for the following reactions: $C^{12}(d,p)C^{13*}$; $Mg^{24}(d,p)Mg^{25*}$; $Be^9(d,p)Be^{10*}$; $Si^{28}(d,p)Si^{29*}$. For each reaction a measurement of the polarization at approximately every 5° between 10 and 80° was made. Deuteron elastic cross sections for the Be^9 and Si^{28} reactions were measured. Data are shown in tables and figures. Results are compared with theoretical predictions and with results of other investigators. The validity of the sign rule and the possibility of determining j_n from proton polarization measurements by some method other than the sign rule are discussed. (A.G.W.)

36717 EVIDENCE FOR MULTIBODY BREAKUP OF THE BORON ISOTOPES BY 25 Mev ALPHAS. 12p. (CONF-46-13)

From American Physical Society Meeting, Washington, D. C., Apr. 1963.

Data taken in experiments designed to seek evidence of α-particle clusters in light nuclei are presented. Results for B^{10} and B^{11} are given; results for Be^9 and C^{12} were reported previously. It is concluded that the 25-Mev α-induced spectra from all stable target nuclei of masses 9 through 12 show a low-energy continuum that can be approximately fitted by a simple three- or four-body phase space distribution. (A.G.W.)

Particle Accelerators

36718 (AD-294575) PARTICLE ACCELERATORS—PRINCIPLES, THEORY, AND DESIGN. Bibliography. (Library of Congress. Aerospace Information Div., Washington, D. C.). Jan. 16, 1963. 45p. (AID-Report-B-63-9)

Four hundred twenty-two references to Soviet-bloc literature on the principles, design and theory of particle accelerators are included. The entries are arranged alphabetically by author, and Library of Congress call numbers are given where they exist. (D.C.W.)

36719 (CONF-114-6) BEAM EXTRACTION FROM THE MURA 50 Mev FFAG ACCELERATOR. F. E. Mills, G. M. Lee, H. K. Meier, J. E. O'Meara, C. H. Pruett, E. M. Rowe, C. A. Radmer, M. F. Shea, D. A. Swenson, and D. E. Young (Midwestern Universities Research Assn., Stoughton, Wis.). Aug. 1963. Contract [AT(11-1)-384]. 11p.

From the International Conference on High Energy Accelerators, Dubna, U.S.S.R., Aug. 1963.

The components, operation, and performance of the beam extraction system are described, and the selection and properties of particle orbits in the extraction channel are discussed. Single accelerated beam pulses were observed to last 37 nsec, and 40 mamp per pulse currents were measured in the extracted beam. The 45-Mev stacked beam was also extracted in a single turn from the 50-Mev electron accelerator. (D.C.W.)

36720 (CONF-114-7) DESIGN STUDIES OF PROTON LINEAR ACCELERATORS. D. E. Young, R. S. Christian, C. D. Curtis, T. W. Edwards, F. J. Kriegler, F. E. Mills, P. L. Morton, D. A. Swenson, and J. Van Bladel (Midwestern Universities Research Assn., Stoughton, Wis.). [Aug. 1963]. Contract [AT(11-1)-384]. 35p.

From the International Conference on High Energy Accelerators, Dubna, U.S.S.R., Aug. 1963.

The use of digital computational techniques in the design of a 200-Mev standing-waye proton linear accelerator for use as an injector for a 12.5 Bev FFAG accelerator is described. A field computational program that permitted evaluation (optimization) of the r-f structure cost for a given accelerator design is described, and typical results are shown. A particle dynamics program is also described. (D.C.W.)

36721 (CONF-114-8) BEAM EXPERIMENTS WITH THE MURA 50 Mev FFAG ACCELERATOR. C. D. Curtis, A. Galonsky, R. H. Hilden, et al. (Midwestern Universities Research Assn., Stoughton, Wis.). [Aug. 1963]. Contract [AT(11-1)-384]. 47p.

From the International Conference on High Energy Accelerators, Dubna, U.S.S.R., Aug. 1963.

Experiments on betatron oscillation frequency, beam lifetimes, multiturn injection, longitudinal bunching, acceleration through the transition energy, energy spread in the accelerated beam, beam stacking procedures, effects of clearing neutralizing ions away from the stacked beam, and instability of the stacked beam are reported. (D.C.W.)

36722 (DESY-A2.101) EXPERIMENTE MIT DER SYNCHROTRONSTRAHLUNG. (Experiments with Synchrotron Radiation). R. Haensel (Deutsches Elektronen-Synchrotron, Hamburg). Aug. 1963. 26p.

The characteristic properties of the radiation emitted by electrons circulating in the synchrotron are graphically compiled. Some description of the facility is included. 43 references. (D.C.W.)

36723 FIRST X SPECTRA OF THE ORBITAL RADIATION OF THE FRASCATI SYNCHROTRON. Yyette Cauchois, Christiane Bonnelle, and Guido Missoni. Compt. Rend., 257: 409-12(July 8, 1963). (In French)

The spectra from an x radiation emitted by electrons of the Frascati synchrotron operating up to 1.1 Bev were obtained between 5 and 14 Å with a vacuum spectrograph and different curved crystals. The K absorption of Al, among others, was observed for the first time with this type of source after very short exposures with respect to usual sources. (tr-auth)

36724 IMPROVEMENT OF THE VACUUM CHAMBER OF 1 Mev CYCLOTRON. M. J. Rhee, S. H. Choh, S. I. Kwon, C. C. Lee, and S. T. Choh (Seoul National Univ., Korea). J. Nucl. Sci., 2: 5-10(1962). (In Korean)

Improvements were made on the vacuum chamber of a 1.2-Mev cyclotron. The chief defects of the former one were related to weakness in beam intensity and incapability of extracting the ion beam out of the chamber. To obtain greater flux of the ion beam, the height of the chamber wall was increased from 4.0 cm of the previous model to 7.0 cm, which makes it possible to enclose the widened hollow dee(3.4 cm thick at center and 2.0 cm at the periphery). In addition the filament of the ion source was replaced by a thicker tungsten wire bent in the shape of a hair-pin, giving increased emission current. The hydrogen gas inlet was placed immediately above the filament so that the collisions between thermoelectrons and hydrogen gas molecules may become more probable. To insert the new chamber, the air gap between pole tips of the electromagnet was widened to 7.4 cm and to avoid the decrease in magnetic flux density due to the widening of the air gap, the upper and lower lids of the chamber were made of soft iron plate of 1.0 cm thick. Thus a magnetic field of 17 kgauss can be obtained at its maximum. As a result of the improvements, the efficiency of the ion source was raised, the emission current through the filament can be increased to 100 mA, and a blue discharge column rising upward from the filament was observed. At this stage, only the internal beam current was measured with the result of 1×10^{-6} A of steady current. (P.C.H.)

36725 ON THE CONSTRUCTION OF A SMALL BETATRON. C. H. Chung, I. H. Song, and B. S. Ahn (Inha Inst. of Tech., [Korea]). J. Nucl. Sci., 2: 19-22(1962). (In Korean)

The design, construction, and operational performance of a small betatron are described. The final energy of the electron obtained is about 4 Mev. The intensity of the x-rays produced is approximately equal to that of one gram of radium in the direction of the electron beam. (auth)

36726 THE DETERMINATION OF MAGNETIC FIELDS FOR A RELATIVISTIC CYCLOTRON WITH FIXED FREQUENCY. F. Krause (Institut fuer Magnetohydrodynamik, Forschungsgemeinschaft, Jena, Ger.). Monatsber. Deut. Akad. Wiss. Berlin, 5: 421-6(1963).

A method for designing a cyclotron that will also operate with particles whose speeds are in the relativistic range is described. All possible magnetic fields, for which the travel time of a particle is independent of its speed, are found following the integration of the equations of motion. The results are discussed in terms of the various parameters. The choice of any particular magnetic field will depend on required cyclotron characteristics. The stability of such a cyclotron is still being studied. (OTS)

36727 HIGH-CURRENT CATHODE FOR ELECTRON LINEAR ACCELERATOR. J. Haimson and I. Brodie (Varian Associates, Palo Alto, Calif.). Nature, 199: 795-7(Aug. 24, 1963).

Thoriated tungsten cathodes for linear accelerators are described that operated satisfactorily in relatively poor vacuum and produced a space charge limited beam at considerably less temperature than older type cathodes. Fabrication and performance data are presented. (C.H.)

36728 HIGH FREQUENCY SYSTEM FOR THE PROTON ACCELERATOR CONSTRUCTED AS A CAVITY RESONATOR. A. A. Glazow, W. A. Koczkin, L. M. Omiszczenko, and J. Schwabe. Nukleonika, 8: 89-100(1963). (In Russian)

A high-frequency system for the proton accelerator is described. This system was constructed as a toroidal

resonator with a high-frequency voltage level between the segments. The results of the first frequency harmonic and the field distribution in the toroidal resonator are cited. An analysis of the operation of the oscillator in the circuit in which the resonator is placed is given. (auth)

36729 EFFECT OF ELECTRON ACCELERATOR BEAM ON ITS ACCELERATING SYSTEM. A. I. Baryshev and S. A. Kheyfets. Radio Eng. Electron (USSR) (English Transl.), No. 3, 454-61(1962).

The excitation of an electromagnetic field by an electron accelerator beam with a cylindrical resonator is discussed. Formulas were derived for the magnitude and phase of the induced voltage and the influence of the excitation on the equivalent circuit parameters was investigated. The modulation of an external oscillator required to obtain a given major change in accelerating voltages was calculated. (Atomdokumentation, 5: No. 1, Jan. 1963)

36730 THE 31-Mev BETATRON FOR MEDICAL USE. Hiroshi Kamogawa, Shun Sugimoto, Hakaru Konii, and Kenjiro Hashimoto (Tokyo Shibaura Electric Co., Ltd.). Toshiba Rev. Intern. Ed., No. 14, 21-5(1963). (In English)

The design of a 31-Mev betatron to be used in fundamental research on radiology and radiation therapy is described. The head of the betatron is composed of a magnet with doughnut, constructed of a special glass with its inner surface covered with a refractory transparent semiconducting film; a lead radiation shield; a variable-field-size beam shutter; electron beam direction adjusting devices; and a diagnostic x-ray apparatus. The electrical circuits are composed of a power circuit pulse generator, an electron direction adjusting device, an initial field correction device, a holding mechanism control board, and a main control desk. The x-ray output obtainable is 140 r/min and the electron output is 3000 r/min from the rotation axis. The noise level is less than 75 phonons at 1 m from the head. Rotational therapy is possible without moving the patient during irradiation. (M.C.G.)

36731 ON LONGITUDINAL STABILITY OF A CHARGED CIRCULATING BEAM IN A CYLINDRICAL RESONATOR. K. A. Barsukov (Lebedev Inst. of Physics, Moscow). Zh. Tekhn. Fiz., 33: 561-4(May 1963). (In Russian)

Longitudinal stability of a charged particle beam circulating in a cylindrical resonator filled with a dielectric with constants ϵ and μ was studied. A dispersion equation was derived for longitudinal oscillations, considering beam curvature. (tr-auth)

36732 ON THE CALCULATIONS OF PHASOTRON ANNULAR MAGNETS. V. N. Kanunnikov. Zh. Tekhn. Fiz., 33: 592-602(May 1963). (In Russian)

The three-dimensional Laplace equation was used for determining the pole profiles and windings for a real, azimuth-dependent field. Approximation formulas were derived for the azimuthal field dependence, operational magnetic flux, and scattering fluxes. Effects of finite magnetic penetrability on magnetic field distribution were analyzed, and additional windings were designed for a smoother control of field index in the working region. (R.V.J.)

36733 ON THE ATTENUATION OF PHASE OSCILLATIONS BY PARTICLE INTERACTIONS WITH ACCELERATING SYSTEMS. A. I. Baryshev. Zh. Tekhn. Fiz., 33: 882-3(July 1963). (In Russian)

Effects of an electromagnetic field on particle gravitational center oscillations were studied. It is shown that such fields do not influence incoherent particle damping and do not change the synchrotron oscillations. (R.V.J.)

36734 CALCULATION METHOD FOR GROUPING WITH V_f = CONST. A. I. Zykov and E. K. Ostrovskii (Khar'kov Inst. of Physics and Tech.). Zh. Tekhn. Fiz., 33: 892-4(July 1963). (In Russian)

Equations for longitudinal electron motion in a linear accelerator with v_{phase} = const $(du/dx) = A \cos \varphi$, $(d\varphi/dx) = (1/\beta) - (u/\sqrt{u^2-1})$ (where $A = (eE_0\lambda_0/2\pi m_0c^2)$ is an infinite parameter of field intensity, u is total electron energy in m_0c^2 units, φ in electron phase in relation to a wave, $x = (2\pi/\lambda_0)Z$ is an infinite length, $\beta_{\tilde{p}} = (v_{phase}/c)$ is an accelerating wave infinite phase velocity, c is the speed of light) were previously resolved by separate integration without finding the direct function for electron energies and their distribution along the accelerator. A simplified variation is given for resolving the above equation and finding the functions $x = x(u,\varphi_0)$. (R.V.J.)

36735 INVESTIGATION OF FORMING SECTIONS WITH CONSTANT WAVE VELOCITY. E. K. Ostrovskii, A. N. Zykov, S. G. Kononenko, L. A. Makhnenko, G. K. Demyanenko, Yu. N. Manovets, and K. S. Rubtsov (Kar'kov Inst. of Physics and Tech.). Zh. Tekhn. Fiz., 33: 735-8 (June 1936). (In Russian)

Axial electron motion in forming sections with constant phase velocities of $\beta = 0.91$ to 1 c was calculated. Experimental data on yield and capture energy were correlated. Effects of the incoming transitions (from the H_{10} wave in a rectangular waveguide to the E_{01} wave in a round diaphragm waveguide) on accelerated electron beam parameters are analyzed. (tr-auth)

36736 DETERMINATION OF OPTIMUM FREQUENCY IN A LINEAR ACCELERATOR WITH A TRAVELLING WAVE AND ENERGY OF ACCELERATED PARTICLES AS A FUNCTION OF FREQUENCY. A. I. Zykov, L. A. Makhenko, E. K. Ostrovskii, G. K. Dem'yanenko, S. G. Kononenko, K. S. Rubtsov, G. D. Kramskoi, and V. B. Mufel (Khar'kov Inst. of Tech.). Zh. Tekhn. Fiz., 33: 739-42(June 1963). (In Russian)

Formulas were derived for determining phase and group velocities in a diaphragm waveguide with a constant wave frequency. Calculations were based on measurements made by the short-circuit piston method. Calculations of relativistic electron energy at an accelerator outlet as a function of frequency were based on measured magnitudes of phase and group velocities and damping in the waveguide. Correlations and direct measurements of maximum energies at various frequencies showed that the relative maximum error of the method does not exceed $\pm 0.01\%$. (R.V.J.)

36737 HEAVY ION ACCELERATOR INSTRUMENTATION (Engineering Materials). (Yale Univ., New Haven). (CAPE-1029)

This package contains 14 drawings. The heavy Ion Accelerator (HILAC) is used for chemical transmutation experiments. There are 2 of these accelerators. One is located at the Lawrence Radiation Laboratory in Berkeley, California and the other is at Yale University in New Haven, Connecticut. Instruments were developed for the Yale HILAC that employ delay line pulse shaping techniques to improve resolution and to prevent "pile up" at high count rates. They include amplifiers, preamplifiers, emitter followers, gates, single channel analyzer, time-to-pulse height converter, power supplies, and a pulse generator. (F.S.)

36738 AUXILIARY EQUIPMENT FOR THE 88 IN. CYCLOTRON (Engineering Materials). California. Univ., Berkeley. Lawrence Radiation Lab.). (CAPE-1005)

This package contains 2 specifications and 36 drawings. Material describing two magnets are included in this package. The 8 in. and 16 in. size, 4 in. aperture quadrupole

magnets are used at the High Current Cyclotron. Mild steel is used for pole tips, pole base, and yokes. This steel should have a magnetic permeability equal to or better than that of SAE-1020. The magnet coils are impregnated with epoxy resin. Specifications are included for impregnating the coils and testing the magnets. See also High Current Cyclotron, CAPE-559. (R.E.C.D.)

36739 VAN DE GRAAFF ACCELERATOR DEVELOPMENT (Engineering Materials). (Oak Ridge National Lab., Tenn.). (CAPE-1012)

This package contains 57 drawings. Various auxiliary equipment is used with the Van De Graaff accelerators at the ORNL. The materials included in this package describe the following: accelerator tube assembly jig, proton tube electrodes, accelerator tube flanges, accelerator tube lens, single corrugation insulator ring, double corrugated electrode insulator ring, ion source pulser for 2.5-Mv Van De Graaff, adjustable lens slits for 3-Mv Van De Graaff, gridded blow-up lens for 3-Mv Van De Graaff, ion source pulser No. 3 for 3-Mv Van De Graaff, duo-plasmatron lens, Model 1 for 3-Mv Van De Graaff, Duo-plasmatron lens-pulser, Model 1 for 3-Mv Van De Graaff, duo-plasmatron lens-pulser, Model II for 3-Mv Van De Graaff, duo-plasmatron lens-pulser, Model III for 3-Mv Van De Graaff, duo-plasmatron lens-pulser, Model IV for 3-Mv Van De Graaff, duo-plasmatron lens-pulser, Model I pulse pick-up, venetian blind pulser, extractor lens for heavy ion pig source, and main lens for duo-plasmatron. Reference drawings are included in CAPEs-315, Health Chemistry Manipulator, 722, Ion Source Pulser, and 876, Duo-Plasmatron Lens Pulser. (R.E.C.D.)

36740 VAN DE GRAAFF ACCELERATOR, 3 Mev (Engineering Materials). (Oak Ridge National Lab., Tenn.). (CAPE-1026)

This package contains 55 drawings. The accelerator was purchased from the Massachusetts Institute of Technology by the ORNL. Since that time, it has been continuously improved and changed until there is little of the original machine remaining. The machine is used to study cross sections of the elements. This study requires short pulse duration and high peak current in the beam pulser to obtain the high resolution requirements in time-of-flight experiments. The neutron detector used with the Van De Graaff accelerator is a Neutron-Time-of-Flight Spectrometer, Q-2557, (see CAPE-1028). (R.E.C.D.)

36741 MAGNETIC DEFLECTION SYSTEMS FOR DEFLECTING CHARGED PARTICLES. Stanley Ernest Hunt (to Associated Electrical Industries Ltd.). British Patent 932,299. July 24, 1963. Filed Feb. 9, 1961.

A system for deflecting a beam of charged particles through 90° and a particle accelerator utilizing the system are patented. Two magnetic deflectors are mounted on a rigid frame, at least one of the deflectors being movable to adjust the distance between the deflectors along the path of the particles. Each deflector can deflect the particles through 45° around a curved path of radius r. If the distance between the deflectors is 2r and the incident beam is parallel sided, the emergent beam will also be parallel. The particles are accelerated in an accelerator before entering the deflecting system. Heavier particles in the beam can be used to provide correcting signals to stabilize the voltage of the accelerator. Accurate control and measurement of the beam energy can be obtained by controlling accurately only the field of the first magnetic deflector. (M.P.G.)

36742 LINEAR ACCELERATORS. (to CSF-Compagnie Generale de Telegraphie Sans Fil). British Patent 935,000. Aug. 21, 1963. Priority date Mar. 24, 1961, France.

A linear particle accelerator that suppresses undesired modes of wave propagation is patented. The accelerator consists of a wave guide having a geometrically periodical structure formed by irises distributed along the length of the wave guide. The irises have central coupling apertures, which vary in size according to an undulatory law, passing through a number of successive maxima and minima. The cavities, which are defined by the irises, vary in size in accordance with the sizes of the apertures of the adjacent irises. In this way the phase velocity of a traveling wave propagated in the guide is adjusted to the accelerated particle velocity. (M.P.G.)

Plasma Physics and Thermonuclear Processes

36743 (AD-287036) RADIATION FROM A LINE SOURCE IN A UNIAXIALLY ANISOTROPIC PLASMA. Technical Report No. 375. H. S. Tuan and S. R. Seshadri (Harvard Univ., Cambridge, Mass. Cruft Lab.). Aug. 25, 1962. Contract Nonr-1866(32). 15p.

Two problems of radiation in a magnetized, incompressible plasma are investigated. The radiation characteristics of a line source of magnetic current are studied for the case in which the external magnetic field is infinite and is oriented in a direction perpendicular to that of the source. The radiation from a uniformly moving line charge is also treated. Two cases are considered, namely; when the motion of the line charge is parallel and when it is perpendicular to the direction of the external magnetic field. In each case it is found that there is a Cherenkov-type radiation for frequencies less than the plasma frequency. The frequency and the angular spectrum, as well as the total energy radiated per unit path length, are determined for both cases. (auth)

36744 (AD-291752) SCATTERING BY A NARROW PERFECTLY CONDUCTING INFINITE STRIP IN A GYROTROPIC MEDIUM. Technical Report No. 380. S. R. Seshadri (Harvard Univ., Cambridge, Mass. Cruft Lab.). Oct. 25, 1962. Contract Nonr-1866(32). 11p.

The scattering of a plane electromagnetic wave of wavenumber k by a perfectly conducting infinite strip of width 2a is investigated for the case in which the surrounding medium is gyrotropic. The gyrotropic axis is taken parallel to the edges of the strip. The problem is formulated in terms of an integral equation whose solution is obtained in the form of a series in powers of ka. Expressions for the far-zone fields and the first two terms in the series for the total scattering cross section are obtained. (auth)

36745 (AD-295198) A THEORETICAL STUDY OF THE MODIFICATION IN ECHO AREA OF SPACE VEHICLES DUE TO THEIR LOCAL SPACE ENVIRONMENT. Quarterly Status Report, December 1, 1961–February 28, 1962. Report 1116-18. (Ohio State Univ. Research Foundation. Antenna Lab., Columbus). Mar. 1, 1962. Contract AF19(604)-7270. 25p.

Progress is reported on determining the change in radar echo area of a satellite due to a plasma sheath and the extent and duration of satellite induced ionization. Topics considered include the determination of ionospheric electron content from Faraday polarization rotation of satellite transmissions, correlation of Doppler shift of WWV radio bursts with passage of a satellite, and methods of calculating electromagnetic scattering by dielectric and dielectric coated conducting bodies. Specific examples illustrating the results obtained are given. (auth)

36746 (AD-413340) SCATTERING BY A PERFECTLY CONDUCTING CYLINDER IN A COMPRESSIBLE PLASMA. Technical Report No. 409. S. R. Seshadri, I. L. Morris, and R. J. Mailloux (Harvard Univ., Cambridge. Cruft Lab.). Apr. 15, 1963. Contract Nonr-1866(32). 20p.

The scattering of a plane electromagnetic (EM) or plasma (P) wave by a perfectly conducting and rigid circular cylinder immersed in an isotropic, compressible plasma is treated. Expressions for all the physical quantities of interest are obtained in the form of infinite series. For the case of a plane EM wave incidence, numerical results for the current induced on the surface of the cylinder, the total scattering cross sections and the back-scattering cross section, are obtained as a function of $k_{eo}a$ for various values of the plasma frequency, where a is the radius of the cylinder and k_{eo} is the wave number of the EM wave in free space. (auth)

36747 (CONF-75-1) PLASMA VORTICES. Winston H. Bostick (Stevens Inst. of Tech., Hoboken, N. J.). [1962]. Contract AT(30-1)-1921. 12p.

From 6th International Symposium on Ionization Phenomena in Gases, Orsay, France, July 1963.

A technique for producing and photographing stationary individual columnar plasma vortices is described and illustrated. Plasma guns are fired across a magnetic field producing circular plasmas that elongate into cylinders along the field. Successive image-converter photographs show the growth of instabilities in the rotating plasma vortex. Observed fluctuations in electric field and ion density inside a laboratory-simulated geomagnetic cavity are believed to be a turbulent superposition of several plasma vortices. (auth)

36748 (D1-82-0192) NON-SIMILAR NUMERICAL METHODS OF SOLUTION FOR ELECTRODE BOUNDARY LAYERS IN A CROSSED FIELD ACCELERATOR. Report No. 63. Gerhard L. Grohs (Boeing Scientific Research Labs., Seattle). Aug. 1962. 56p. (AD-290525)

A numerical method of solution for the electrode boundary layer problem in a crossed-field plasma accelerator is presented, which allows a direct study of non-similar properties of the boundary layer profiles. The method is applicable not only to a wide variety of free stream solutions with or without Hall effect, but in essence to compressible boundary layers in general. Suggestions for a modification of the Karman-Pohlhausen integral technique are discussed also. (auth)

36749 (LADC-5798) ANALYSIS OF THE 0(VIII) LYMAN SPECTRUM FROM A TRANSIENT LABORATORY PLASMA. F. C. Jahoda, F. L. Ribe, G. A. Sawyer (Los Alamos Scientific Lab., N. Mex.); and R. W. P. McWhirter (United Kingdom Atomic Energy Authority. Research Group. Culham Lab., Culham, Abingdon, Berks, England). [1962]. Contract [W-7405-eng-36]. 17p. (CONF-75-6)

From 6th International Symposium on Ionization Phenomena in Gases, Orsay, France, July 1963.

The 0 VIII resonance spectrum occurs between 14 and 19 Å. Measurements of the line intensities from a theta-pinch ($T_e \approx 300$ ev, $n_e \approx 7 \times 10^{16}$ cm^{-3}, $t \approx 1$ μsec) are compared with recent numerical calculations for one-electron ions in an optically thin plasma. Substantial agreement is obtained when the transient state of the plasma is explicitly included. (auth)

36750 (LRP-3-63) HEATING AND CONFINEMENT OF A PLASMA BY ALTERNATING MAGNETIC FIELDS. Erich S. Weibel (Laboratorie de Recherches sur la Physique des Plasmas, Lausanne, Switzerland). [1963]. 27p.

A method is proposed in which a plasma is confined by an alternating magnetic field. The plasma is field free except in a thin boundary layer. No diffusion takes place since this boundary is periodically reconstituted by the field, maintaining the penetration depth at the fixed value c/w_p. The confining field heats at the same time both electrons and ions, at high temperatures preferentially the latter. This heating is very efficient. About half of the total applied power is absorbed by the plasma, the rest being copper losses. The technical feasibility is examined and numerical examples are given. (auth)

36751 (MATT-139) A PROBE SYSTEM FOR STELLERATOR PLASMA RESEARCH. J. M. Chapuk, V. L. Corso, V. S. Foote, W. L. Harries, R. M. Sinclair, J. L. Upham, and S. Yoshikawa (Princeton Univ., N. J. Plasma Physics Lab.). June 1962. Contract AT(30-1)-1238. 42p.

A remote-controlled Langmuir probe system is described which operates at high temperature (50 ev), high density (3×10^{13} cm^{-3}), stellarator pulsed discharges with plasma currents of up to 10 R amp (current density of 150 amp/cm^2) in confining fields of up to 50 kgauss. Experimental results are shown of probe ion current vs time and position, and also of plasma density profiles perpendicular to the stellarator axis. Calculated average plasma densities from these profiles are about 20% higher than those measured in a 4 mm microwave system. The current-voltage traces show approximately Maxwellian electron energy distributions, and give temperature as a function of position and time. The space averaged values at given times are about twice as high as estimated from the plasma conductivity. (auth)

36752 (MATT-153) ASYMPTOTIC THEORY OF SPHERICAL ELECTROSTATIC PROBES IN A SLIGHTLY IONIZED, COLLISION DOMINATED GAS. Ira M. Cohen (Princeton Univ., N. J. Plasma Physics Lab.). Nov. 1962. Contract AT(30-1)-1238. 40p.

The problem of an electrostatic probe in a dense, slightly ionized gas is treated by techniques of asymptotic analysis. The asymptotic limits $\rho_p = r_p/\lambda_d \to \infty$ and $\tau = T_-/T_+ \to \infty$ are treated in considerable detail. (r_p, λ_d, T_-, T_+ are probe radius, Debye length, electron, and ion temperature, respectively.) Sample integral curves for electrostatic potential, ion and electron density are given, as well as probe characteristic curves for many values of τ (finite and large) and ρ_p (large). It is noted that these characteristics do not saturate for large probe potential because the influence of the probe is felt to very great distances from the probe; the shielding due to the space sheath is incomplete. (auth)

36753 (PAN-379/IX) HEATING OF PLASMA IN THE CIRCULARLY POLARIZED ELECTROMAGNETIC WAVE. A. Legatowicz (Polish Academy of Sciences. Inst. of Nuclear Research, Warsaw). Dec. 1962. 18p.

The motion of a charged particle in a circularly polarized electromagnetic wave and a constant perpendicular homogeneous magnetic field, as well as the energy transfer to the ionic part of the plasma, is calculated taking into account the plasma electromagnetic field. Expressions for the time required for a deuteron to reach the energy 10^9 °K and for the mean energy transfer to one ion are derived. (D.C.W.)

36754 (PIBMRI-929-61) THE PENETRATION OF MAGNETIC FIELDS IN INCOMPRESSIBLE PLASMAS. PART II. Memorandum 30. M. Goldstein (Brooklyn. Polytechnic Inst. Microwave Research Inst.). June 28, 1961. Contract AF30(602)-2149. 6p. (AD-294499)

The series previously obtained for the field H(t) in the loop used as a model is shown to converge for t = l/V. The velocity of the step current source as a function of time is derived from power considerations, and maximum energy delivery to the source is shown to occur when the power equals zero. (D.C.W.)

36755 (PIBMRI-956-61) HYDRO-MAGNETIC STABILITY OF AN ELECTRODELESS PLASMA STRUCTURE. Memorandum 34. K. T. Lian (Brooklyn. Polytechnic Inst. Microwave Research Inst.). Oct. 20, 1961. Contract AF30(602)-2149. 9p. (AD-294495)

An electrodeless plasma switch structure is described, and the requirements for its hydromagnetic stability are examined. The dynamics of the structure are also analyzed. (D.C.W.)

36756 (PIBMRI-974-61) LATERAL WAVES ON AN ANISOTROPIC PLASMA INTERFACE. Memorandum 74. L. B. Felsen (Brooklyn. Polytechnic Inst. Microwave Research Inst.). Jan. 5, 1962. Contract AF19(604)-4143. 13p. (AD-294492)

The effects of an anisotropic plasma interface on the radiation from a longitudinal electric current element in a homogeneous plasma half space are examined. Reflection and refraction of lateral waves particularly, are considered. (D.C.W.)

36757 (PIBMRI-100i-62) HYDROMAGNETIC FLOW CHARACTERIZED BY LARGE MAGNETIC REYNOLDS NUMBERS. Memorandum 38. Richard Sasiela (Brooklyn. Polytechnic Inst. Microwave Research Inst.). May 14, 1962. Contract AF30(602)-2149. 30p. (AD-294414)

The flow of plasma across a magnetic field was studied in the case of strong interactions. Sets of nonlinear differential equations governing the flow were derived both from the macroscopic and microscopic viewpoint taking into account only binary collisions. The sets of equations are shown to be exactly equivalent and are solved for the steady state distribution of magnetic field strength B and particle density n. Solutions are also derived for the case of anomalous diffusion caused by collective modes and these are compared with the results previously obtained. (auth)

36758 (PIBMRI-1058-62) RADIATION FROM A UNIAXIALLY ANISOTROPIC PLASMA HALF SPACE. L. B. Felsen (Brooklyn. Polytechnic Inst. Microwave Research Inst.). Aug. 27, 1962. Contract AF19(604)-4143. 41p. (AD-294877; AFCRL-62-759)

A line source of magnetic currents is located in a half space with uniaxially anisotropic dielectric constant, with the optic axis inclined at an arbitrary angle to the interface. This two-dimensional, scalar diffraction problem is solved by Fourier integral techniques, and the solution is examined in the asymptotic range of large distance from the source. The radiation field comprises incident, reflected and refracted ray contributions whose properties are determined from a study of the refractive index curves for the medium. In addition, there may exist a lateral wave which is excited by a critically refracted incident ray, and which sheds energy back into the anisotropic medium by refraction. If the medium is a plasma with an externally impressed infinite d-c magnetic field, and if the source oscillates below the plasma frequency, there exist shadow regions from which the direct and reflected rays are excluded but which can be penetrated by the lateral waves. (auth)

36759 (PIBMRI-1069-62) ON THE THEORY OF RADIATION FROM SOURCES IN PLANE STRATIFIED ANISOTROPIC PLASMA MEDIA. E. Arbel and L. B. Felsen (Brooklyn. Polytechnic Inst. Microwave Research Inst.). Sept. 25, 1962. Contract AF19(604)-4143. 41p. (AFCRL-62-760; AD-295075)

The radiation from arbitrary source distributions in plane stratified, anisotropic media is presented. The formal solutions are obtained by an extension of modal procedures familiar from the analysis of isotropic waveguide regions. Special attention is given to the formulation of a radiation condition that requires the flow of energy away from the sources, and to its interpretation utilizing the refractive index surfaces descriptive of plane wave propagation in an anisotropic medium. These concepts are are illustrated in detail for an ionized plasma under the influence of an external steady magnetic field. 35 references. (auth)

36760 (PIBMRI-1093-62) SURFACE WAVES ON PLASMA SLABS. Memorandum 85. P. Hirsch and J. Shmoys (Brooklyn. Polytechnic Inst. Microwave Research Inst.). Oct. 18, 1962. Contract AF30(602)-2045. 6p. (AD-294498)

The conditions that must be satisfied for surface waves to propagate along a gradual transition between two uniform plasma regions are examined by assuming that the plasma dielectric constant depends only on the electronic number density and by describing propagation in terms of specified uniform transmission lines. The gradual electron density increase from one uniform region to the other is approximated by a series of steps. (D.C.W.)

36761 (UCRL-7363) COMMAND RESONANCE CHARGING SYSTEM FOR THE ASTRON ACCELERATOR. K. A. Saunders and R. L. Sewell (California. Univ., Livermore. Lawrence Radiation Lab.). May 14, 1963. Contract W-7405-48. 21p.

The 5-Mev, 200-amp, electron source for the Astron machine is a magnetic induction linear accelerator consisting of a series of pulse transformers fed from 471 parallel, 36-megawatt, line-type modulators. The pulse forming networks for the modulators are parallel, RG-218/U coaxial cables, with a length of 0.4 μsec. The pulse forming networks are charged by four command resonance-charge, voltage-regulated, power supplies, each capable of furnishing 35 kv ± 0.2%, 60 pps into a 3.3-μF load. The voltage is regulated over the range of 20 to 35 kv, independent of repetition rate, by a crowbar circuit. Methods for reducing the effects of transients are presented. (auth)

36762 (UCRL-10849) AN EXPERIMENTAL INVESTIGATION OF THE STATE OF A HIGHLY IONIZED DECAYING HYDROGEN PLASMA (thesis). William Samuel Cooper, III (California. Univ., Berkeley. Lawrence Radiation Lab.). June 17, 1963. Contract W-7405-eng-48. 117p.

The rate of decay of an initially highly ionized, dense H plasma and departures of the state of the plasma from thermodynamic equilibrium are investigated. The atomic processes governing such decay are discussed, and the theory necessary for determining the plasma properties from a spectroscopic analysis of the emitted radiation in the visible and ultraviolet spectral regions is derived. The formation of such a plasma in a strong magnetic field by a hydro-magnetic ionizing wave, and its subsequent decay, were studied experimentally. The decay rates obtained agree well with calculations by Bates, Kingston, and McWhirter for a plasma opaque to the Lyman series lines. The plasma also cooled essentially in thermodynamic equilibrium until the temperature dropped below about 1.2×10^4 °K. 77 references. (D.C.W.)

36763 THE CROCCO THEOREM IN MAGNETOGASDYNAMICS. Ferdinand Cap and Raimund Hommel (Universität, Innsbruck, Ger.). Ann. Physik (7), 11: 132-7 (1963). (In German)

A relation between the entropy gradients and the vortex strength (Crocco theorem) was derived for a quasineutral plasma. The conditions under which potential streaming can occur in a plasma were discussed. (tr-auth)

36764 PULSE DISCHARGE IN DENSE PLASMAS. K. H. Hoecker, W. Kluge, and H. Schrade (Technische Hochschule, Stuttgart). Ann. Physik (7), 11: 175-89(1963). (In German)

A summary representation is given of investigations on ohmic heating. Experimentally a high current pulse discharge over a gas-vortex-stabilized, high-temperature arc in nitrogen and hydrogen atmospheres was the basis. The theory treats the problems in a channel model corresponding to the study. The transfer of the energy obtained in the electric field to random motion as a result of scattering processes was studied, considering possible energy losses. In the case of nitrogen, the heating at a temperature of approximately 85,000°K was almost compensated by the loss mechanism, here chiefly radiation. The losses lead to a channel broadening because of radiation transport. In the case of hydrogen pulses, the heating is limited because the plasma channel is unstable. The maximum temperature to be expected is about 300,000°K at atmospheric pressure and about 500,000°K at 10 atm. The diagnostic method used in the evaluation of the discharge phenomena was described briefly. (tr-auth)

36765 POTENTIAL STREAMING IN MAGNETOGASDYNAMICS. Ferdinand Cap (Universität, Innsbruck, Ger.). Ann. Physik (7), 11: 197-200(1963). (In German)

It was shown that for a plasma in which potential streaming occurs the same potential equation is valid as for a neutral gas. Energy terms, Bernoulli equations, and discharge formulas were discussed. (tr-auth)

36766 POSITION OF THE ATTACHED SHOCK WAVE IN CONICAL FLOW. Max Bausset. Compt. Rend., 257: 372-4(July 8, 1963). (In French)

The results obtained previously on shock waves in aerodynamics (Compt. rend., 254: 1572(1962)) are extended to the case of fluid magnetodynamics. (tr-auth)

36767 THE STABILITY OF SHOCKS ATTACHED TO THE POINT OF A DIHEDRAL. Henri Cabannes. Compt. Rend., 257: 375-8(July 8, 1963). (In French)

The stable stationary shocks, slow shocks, and fast shocks that, in fluid magnetohydrodynamics, can be attached to the point of a dihedral were determined and measured. (tr-auth)

36768 COMPUTER SOLUTION OF THE MOVEMENT OF CHARGED PARTICLES WITH DIFFERENT SIGNS AND MASSES IN "MAGNETIC BOTTLE" FIELDS. S. P. Lomnev (Computer Center, Academy of Sciences, USSR). Dokl. Akad. Nauk SSSR, 151: 315-17(July 11, 1963). (In Russian)

Charged particles of the same sign were previously found to diffuse in both longitudinal and crosswise directions within the magnetic field (Doklady Akad. Nauk SSSR 148, No. 5 (1963)), making it possible to determine the diffusion by changes in the field parameters; losses start to appear at densities of 10^5 particles/cm^3. The study was extended to a consideration of the movement of charged particles of different signs and masses exposed to the effect of longitudinal magnetic fields, taking scattering into account. These phenomena are considered as the diffusion of nonhomogeneous plasma. The derived equations were solved by a special computer program. The results, although incomplete, allow the conclusion that because of the movement of the electrons, the ideal condition of the plasma is destroyed; the electrons are accelerated, while their energy spectra become less sharp. The results were used for the preparation of a computer model of the phenomenon. Two specific cases were considered: application of a negative field to positively charged particles placed in a regular spatial lattice and consideration of the accelerating mechanism, i.e., of the positive charge, across the uniform space lattice. The final results did not indicate a noticeable improvement of the confinement conditions of the particles. (TTT)

36769 MOTION OF THE INDIVIDUAL CHARGED PARTICLES IN A MAGNETIC FIELD WHICH INCREASES TOWARDS THE PERIPHERY. V. M. Balebanov, B. I. Volkov, V. B. Glasko, A. L. Groshev, V. V. Kuznetsov, A. G. Sveshnikov, and N. N. Semashko (Kurchatov Inst. of Atomic Energy, Academy of Sciences, USSR and Moscow State Univ.). J. Nucl. Energy, Pt. C, 5: 205-22(July-Aug. 1963). (In English)

The motion of the individual charged particles in a magnetic trap is discussed. The trap is formed by an axially-symmetric field upon which a transverse field produced by straight rods carrying currents which flow in alternate directions is superimposed. These rods are arranged around a cylinder parallel to the axis of the trap. It is shown that if particles are injected into such a trap in a definite way provided their magnetic moment is conserved they become trapped within it. The magnetic drift of the particles that arises in such a system inhibits the development of flute instability of the plasma boundary. Results of calculations carried out in the drift approximation, and by numerically integrating the exact equations of motion, are confirmed experimentally. (auth)

36770 PARTICLE BEHAVIOR IN INDEPENDENTLY ESTABLISHED ROTATING E- AND B-FIELDS. F. G. Insinger, H. J. Hopman, and J. Kistemaker (FOB-Laboratorium voor Massascheiding, Amsterdam). J. Nucl. Energy, Pt. C, 5: 223-8(July-Aug. 1963). (In English)

In a configuration of rotating crossed E and B fields, which are independently established, the behavior of charged particles is investigated. A resonance condition is found, even in the presence of a stationary B_z-field parallel to the axis of rotation. Particles travel predominantly in this direction. This combination of fields can be made to act either as a velocity discriminator, accelerator, reflector, or injector. A numerical example of the last case is given with the following typical values: rotating field strengths of 50 v/cm and 10^3 G at a frequency of rotation of 10^5 H_z; stationary field-strength B_z of 10^4 G. When starting with zero energy the particle gains 600 ev after traveling a distance of 50 cm. (auth)

36771 ENERGY SPECTRUM AND THE MASS OF IONS IN A PLASMA JET. C. Renaud and J. Tachon (Euratom-CEA, Fontenay-aux-Roses, France). J. Nucl. Energy, Pt. C, 5: 235-41(July-Aug. 1963). (In French)

The energy spectrum of ions generated by a gun with hydrogenated titanium washers is determined by an electrostatic analyzer equipped with an ion detector using scintillation techniques. The plasma is injected along a static magnetic field whose intensity can be varied up to 1100 G. For H^+, Ta^+, and Ta^{++} ions, the most probable energy is included between 700 and 1100 ev. A hardening of the spectrum is observed when the intensity of the guiding magnetic field is increased, the average energy varying from 1 to

1.5 kev. Using a time of flight technique, it is shown that the emission of the more energetic ions occurs at the beginning of the discharge. The various ion species are determined. In the absence of guiding field, the duration of the emission of ions, with a fixed energy, is included between 0.5 and 1 μsec. The width of the signal increases when the guiding magnetic field is on. (auth)

36772 STABILITY OF GAS-INSULATED PLASMA. S. P. Talwar and J. N. Tandon (Univ. of Delhi, India). J. Nucl. Energy, Pt. C, 5: 243-4(July-Aug. 1963). (In English)

The dispersion relation for a cylindrically pinched plasma column, surrounded by an unlike gas that extends to the wall of the pinch tube, is found. The critical wave number, below which the plasma is unstable, is unchanged by the addition of the gas between the pinch and the wall. The stability conditions of the plasma–insulating gas–wall system are determined, and it is found that the compressibility or incompressibility of the insulating gas has no effect on the stability. (T.F.H.)

36773 MICROWAVE AMPLIFICATION BY INTERACTION BETWEEN ELECTRON BEAM AND PLASMA. Teiichi Kurobe and Yoshihiko Ogawa. Mem. Fac. Eng., Hokkaido Univ., 11: 403-17(Mar. 1963).

When an electron beam modulated by a microwave signal passes through plasma in which the plasma frequency is close to the frequency of this signal, then the electrons agitated thermally in the plasma oscillate with this frequency, and consequently an electron space-charge wave grows in the plasma. When this wave and the slow and fast space-charge waves in the electron beam interact mutually, it may be expected that the microwave signal in the electron beam is amplified. This problem is analyzed theoretically. First, the propagation constants and the characteristic impedance of the electron space-charge wave in the plasma are analyzed. Next it is confirmed that the space-charge wave in the electron beam can be amplified by mutual coupling with the electron space-charge wave in the plasma. Finally the amplification action by three-modes coupling between the electron space-charge wave in the plasma and the slow and fast electron space-charge waves in the electron beam is confirmed. As a result of a numerical example, the gain of this amplifier is considerably high (approximately 38 db/cm), although its frequency band-width is very narrow (less than 60 kc). (auth)

36774 NONUNIFORM EXPANSION OF A PISTON INTO AN IONIZED MEDIUM WITH A WEAK MAGNETIC FIELD. Nathan Ness, Jerome B. Fanucci, and Louis J. Kijewskii (Radio Corp. of America, Moorestown, N. J.). Phys. Fluids, 6: 1241-9(Sept. 1963).

The nonuniform expansion of a rigid, perfectly conducting piston into an infinitely conducting fluid wherein there exists a weak uniform magnetic field is considered. A solution for the state of the plasma and the magnetic field between the piston and the magnetohydrodynamic shock is obtained by a small perturbation method; the dependent variables are expressed in double expansions about a zero order (hydrodynamic) solution. The solution is valid for pistons (either cylindrical or spherical) whose expansion velocity is expressible by a small perturbation on a constant velocity. The development includes second order terms; however, numerical results are restricted to first order. Within the first order perturbation, it is shown that the fluid dynamic analysis is uncoupled from the magnetic field, and the shock shape retains its cylindrical or spherical symmetry. Calculations are carried out for a spherical piston, for several values of γ (specific heat ratio), and a_∞/v_0 where a_∞ is the ambient speed of sound and v_0 is the uniform piston velocity. The results show that the shock velocity is nearly insensitive to changes in the piston velocity. (auth)

36775 MAGNETO-FLUID DYNAMIC TURBULENCE WITH A UNIFORM IMPOSED MAGNETIC FIELD. Robert C. Deissler (Lewis Research Center, Cleveland). Phys. Fluids, 6: 1250-9(Sept. 1963).

Two point correlation and spectral equations for this case are derived from the equations of fluid and electrodynamics. Solutions are obtained by assuming that the turbulent field is homogeneous and weak enough for triple correlations to be negligible. For initial conditions, it is postulated that the turbulence is initially isotropic, and that the turbulent magnetic field fluctuations are initially zero. The interaction of the mean magnetic field with the turbulent velocity field then causes magnetic field fluctuations to arise at later times. In general, the turbulent energy in the mechanical and magnetic modes tends toward equipartition for large values of time or of mean magnetic field. However, when the kinematic viscosity is much less than the electrical resistivity (or magnetic diffusivity), as for liquid metals, equipartition is not approached before the turbulence is damped out by the mean magnetic field. (auth)

36776 INITIAL RESPONSE OF THE SPECTRUM OF ISOTROPIC TURBULENCE TO THE SUDDEN APPLICATION OF A STRONG MAGNETIC FIELD. James A. Nestlerode and John L. Lumley (Pennsylvania State Univ., University Park). Phys. Fluids, 6: 1260-2(Sept. 1963).

A strong uniform magnetic field is suddenly imposed on a mass of conducting incompressible fluid initially in isotropic turbulent motion. Initial time derivatives of the spectrum are calculated through third order. After identification of terms, the simplifying assumptions of large mechanical and small magnetic Reynolds numbers are made, and the initial three-dimensional spectrum assumed to be a Dirac shell; these permit the calculation and plotting of the one-dimensional spectra. Interpretation of these spectra leads to the conclusion that the immediate effect of the field is to attenuate modes having cross-field velocities and those having cross-field node lines. (auth)

36777 BIMODAL DISTRIBUTIONS AND PLASMA SHOCK WAVE STRUCTURE. G. G. Comisar (Aerospace Corp., Los Angeles). Phys. Fluids, 6: 1263-7(Sept. 1963).

The distribution of molecular velocities in a strong shock wave is usually assumed to be bimodal, on the basis of mean free path arguments. Indeed, this assumption has been confirmed by Sakurai for the case of rigid sphere molecules. It turns out that such a confirmation is no longer possible when the intermolecular forces have sufficiently long ranges; in particular, it is shown that, for the case of a fully ionized gas, the Boltzmann equation is not satisfied by a bimodal distribution, regardless of the choice for the shock thickness parameter and Mach number. This breakdown of the bimodal solutions is ascribed to an inadequacy in the usual mean free path concept for a plasma, due to the dominance of weak collisions at high temperatures. (auth)

36778 DYNAMIC FRICTION AND ION WAVE RADIATION REACTION IN A PLASMA. S. Rand (Inst. for Defense Analyses, Washington, D. C.). Phys. Fluids, 6: 1268-79(Sept. 1963).

The reaction forces of a small charged body which traverses a low density plasma were studied. The contributions to these forces are discussed with respect to individual particle and collective plasma action, with the relationships between these two contributions demonstrated.

The reaction forces are obtained for a subsonic accelerating body, and, in various limiting cases, for a supersonic body undergoing a small degree of acceleration. (auth)

36779 PARTITION FUNCTIONS AND THERMODYNAMIC PROPERTIES OF ARGON PLASMA. K. S. Drellishak, C. F. Knopp, and Ali Bulent Cambel (Northwestern Univ., Evanston, Ill.). Phys. Fluids, 6: 1280-8(Sept. 1963).

The equilibrium chemical composition and the thermodynamic properties of argon plasmas were calculated for five pressures (0.1, 0.5, 1.0, 2.0, and 5.0 atm) at 100 K deg increments for the temperature range 5000 to 35,000°K. The argon plasma is assumed to be a perfect gas complex consisting of six components, namely electrons, argon atoms, and the first four argon ions. The partition functions for these were calculated using tabulated data for observed atomic energy levels and estimated energies for energy levels that are predicted although not observed. The partition functions were terminated by application of the Debye cutoff criterion and a corresponding lowering of the ionization potential was included. The calculated data are presented in graphical form and the method followed in calculating the partition functions is evaluated. (auth)

36780 COLLECTIVE ELECTRON INSTABILITY IN A BOUNDED REGION. M. N. Rosenbluth, L. D. Pearlstein, and G. W. Stuart (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Phys. Fluids, 6: 1289-98(Sept. 1963).

The linearized Vlasov equation is employed to investigate the stability of the various equilibrium solutions determined from the following model: an infinite slab of width 2L contains a uniform density N of infinitely massive, singly charged, positive ions. The bounding planes (cathodes) emit fixed Maxwellian electron distributions and absorb all impinging electrons, so that the total number of electrons in the system, and their energy, need not remain constant. This model permits three types of time-dependent, equilibrium solutions for the electron distribution. One of these solutions shows a Maxwellian electron velocity distribution everywhere in the slab and is stable. The other two types of solution have regions where the electron velocity distribution is not Maxwellian. These latter solutions are shown to be unstable for a range of system parameters to a longitudinal electron collective mode with a growth rate on the order of $\omega_p \equiv (4\pi e^2 N/m)^{1/2}$. (auth)

36781 EXCITATION OF LONGITUDINAL WAVES IN A BOUNDED COLLISIONLESS PLASMA. Edward C. Taylor (Aerospace Corp., Los Angeles). Phys. Fluids, 6: 1305-12 (Sept. 1963).

The relativistic form of the Vlasov equation is used to derive an integral equation for an externally produced electric field oscillating with frequency ω in a plasma bounded by two specularly reflecting walls. A tentative solution is constructed from exact solutions of the half-space problem. It is shown that the exact equation is satisfied by the tentative solution up to terms which are exponentially small in the number of Debye lengths across the plasma. It happens that the bounded plasma acts like a medium with a dielectric constant $\kappa = [1 - \omega_p^2/\omega^2(1 - 5kT/2\ mc^2)]$, unless the driving frequency lies in the small band $\omega_p^2(1 - 5kT/2\ mc^2) < \omega^2 < \omega_p^2(1 + kT/2\ mc^2)$. When the driving frequency satisfies the inequality, then the plasma also supports standing waves which satisfy the relativistic dispersion relation for longitudinal waves. (auth)

36782 EQUATIONS OF MOTION OF A CURRENT-CARRYING PLASMA FILAMENT. T. S. Lundgren (Univ. of Minnesota, Minneapolis). Phys. Fluids, 6: 1313-19 (Sept. 1963).

The equations of motion of a perfectly conducting current-carrying, plasma filament are derived from Hamilton's principle. The result is a nonlinear second order vector partial differential-integral equation, the solution of which gives the equation of the centerline of the filament. This is extended to the dissipative case for an incompressible fluid. A stability example is worked out. (auth)

36783 CONVECTIVE FLEXURE OF A PLASMA CONDUCTOR. Paul Thiene (MHD Research, Inc., Newport Beach, Calif.). Phys. Fluids, 6: 1319-24(Sept. 1963).

The basic magneto-fluid-dynamical and electromagnetic equations are applied to study the flexure of an electrically neutral plasma conductor subjected to low Mach number subsonic forced convection. The basic equations, in particular the equation of energy balance, are shown to provide a linear relation between the curvature of the conductor and the mass flux of convection. For a given mass flux the curvature is found to vary inversely with a parameter introduced as the flexural rigidity of the conductor. The flexural rigidity is proportional to the coefficient which relates to the thermal conduction and the enthalpy flux due to diffusion. The flexural rigidity also increases with radiation losses and is inversely proportional to the specific heat at constant pressure. The theory is compared favorably with the results of an experimental investigation of the deflection of an arc positive column drawn between local, collinear electrodes in argon near atmospheric pressure. The arc current was varied from 2 to 6 amp for various incident convection velocities normal to the interelectrode axis up to approximately 200 cm/sec. (auth)

36784 AZIMUTHAL MAGNETIC FIELD IN THE CONICAL THETA PINCH. Winston H. Bostick (Stevens Inst. of Tech., Hoboken, N. J.) and Daniel R. Wells. Phys. Fluids, 6: 1325-31(Sept. 1963).

A simple current-sheet model of a hydromagnetic shock is employed in an attempt to explain the origin of the B_θ and $v_{poloidal}$ observed previously in the hydromagnetic vortex rings produced in the conical θ pinch. Although this simple model has its limitations, it nevertheless shows clearly that the B_θ and the vortex structure are due to Hall currents which are driven by shear in acceleration, and that the existence of any right handedness and left handedness and of the plasma vortex structure itself depends upon the fact that negative electricity (electrons) are light and positive electricity (protons) are heavy. The model also gives a plausible explanation and description of the origin of θ rotation, i.e., v_θ in the θ pinch. (auth)

36785 WALL STABILIZATION EFFECTS IN THETA-PINCH CONFIGURATIONS. R. W. Kilb, H. Hurwitz, Jr., and W. F. Westendorp (General Electric Research Lab., Schenectady, N. Y.). Phys. Fluids, 6: 1332-7(Sept. 1963).

If flux cannot penetrate into the conducting walls of a theta-pinch coil, then a repulsion force arises as a diamagnetic plasma approaches the coil wall. This results from the three-dimensional curvature of the flux lines when the plasma is near the wall. Neglecting changes in plasma shape, the stabilization energy is obtained by computing the energy needed to turn on the plasma surface currents in the presence of the coil wall. This is done accurately for spherical plasma shapes in cylindrical coils, and approximately for ellipsoidal shapes. The stabilization energy of spheres is proportional to the square of their volume, and becomes effective within a sphere diameter from the wall. It is approximately 10% of the energy needed to introduce the sphere into the coil center. Ellipsoids show roughly the same stabilization as spheres, but the force comes into play farther from the wall. By

replacing the plasma with a conducting object of the same shape, an analog experiment is performed to determine the change in inductance as the object is moved about in the coil. For spheres and ellipsoids, agreement is found between the calculations and experiment. The experiment may be used to find the stabilization for complex shapes. (auth)

36786 ROTATIONAL INSTABILITY IN THE THETA PINCH. H. A. B. Bodin and A. A. Newton (United Kingdom Atomic Energy Authority, Aldermaston, Berks, Eng.). Phys. Fluids, 6: 1338-45(Sept. 1963).

An experimental study of the rotation and associated instability was made in a theta pinch with a peak field of 85 kG reached in 2.3 μsec. The starting deuterium gas pressure was in the range 50 to 150 μ Hg, and for operation on the second half-cycle of the sinusoidal driving field the magnetic flux trapped within the plasma varied between ±100 kMx. In most conditions the circular cross section of the plasma became perturbed along its length by the growth of two flutes which rotated at an angular velocity of up to 6×10^7 rad/sec. It is deduced from measurements on the rotation that the plasma acquires its angular momentum at the start of the half-cycle, and the results are interpreted on the basis that the angular momentum is initially in a diamagnetic (azimuthal) ion current. A model is described for establishing this current as a consequence of contact between the plasma and the walls. Results on the time of onset of the instability, and on the growth rate of the flutes, point to the existence of some damping or stabilizing process; it is found that field diffusion, or a rapid axial contraction of the plasma (due to closed reversed field loops), can lead to instability, and when these are reduced the stable time is increased. The possible influence of finite Larmor radius stabilization is discussed. The stability condition, originally derived for low β but recently shown to have more general validity, is in qualitative agreement with the results. (auth)

36787 NOTE ON THE RELATIVE IMPORTANCE OF COLLISION AND TEMPERATURE EFFECTS ON WAVE PROPAGATION IN A PLASMA. H. Motz (Oxford Univ.). Phys. Fluids, 6: 1358-9(Sept. 1963).

Physical interpretation is given to the conditions under which collision effects on wave propagation in a plasma can be neglected with respect to the temperature effects. (R.E.U.)

36788 SIMPLE PICTURE OF THE FINITE LARMOR RADIUS STABILIZATION EFFECT. F. C. Hoh (Royal Inst. of Tech., Stockholm). Phys. Fluids, 6: 1359(Sept. 1963).

The effect of finite Larmor radius is taken into account in order to stabilize a weakly unstable plasma. The stabilization effect arises from the fact that the large orbit ions drift slower than the electrons in an inhomogeneous electric field. (R.E.U.)

36789 MAGNETOGASDYNAMIC SCALING LAWS FOR A PERFECT GAS. Clark H. Lewis (ARO, Inc., Arnold Air Force Station, Tenn.). Phys. Fluids, 6: 1360-1(Sept. 1963).

Scaling laws are extended to include a compressible, perfect gas. Continuity, momentum, and energy equations and equations of state are given. (R.E.U.)

36790 PLASMA CONDUCTIVITY KERNEL AND ACCRUAL OF PERTURBATIONS ALONG PARTICLE HISTORIES. D. Dobrott (Stanford Electronics Labs., Calif.). Phys. Fluids, 6: 1362-3(Sept. 1963).

The current density, which flows in response to a perturbing field is calculated by means of an integral operator. The conductivity kernel, contained in this operator, is a tensor derivable from the linearized Boltzmann equation. The motion of an individual particle in the plasma depends not only upon the electromagnetic fields at a particular time, but also upon the particular past history. Accrual of perturbations along particle orbits is used in the description of the transport of phenomena in a plasma by noncolliding particles. (R.E.U.)

36791 MOVEMENT OF A PLASMA BUNDLE ALONG GUIDING ELECTRODES. A. K. Musin. Radio Eng. Electron. (USSR) (English Transl.), No. 3, 515-24(1962).

The movement of a plasma bunch was examined for the limiting cases of a strong external magnetic field and rapidly changing inductance of the accelerating circuit. In the latter case, when an exact solution was not realized, a qualitative analysis was made, and with the help of an asymptotic method, an approximate analytical solution was plotted. (Atomdokumentation, 5: No. 1, Jan. 1963)

36792 VARIATION OF DIRECTIONAL ELECTRON CURRENT IN A GASEOUS DISCHARGE ACTED UPON BY A MICROWAVE FIELD. G. D. Lobov and V. V. Zakharov. Radio Eng. Electron. (USSR) (English Transl.), No. 4, 614-24(1962).

The effect of a microwave field on directional electron velocity in a gas discharge was investigated. In the presence of microwave power the mean directional electron velocity is shown to increase, with simultaneous rise of the discharge current through the tube. A method is proposed for direct determination of directional electron velocity, based on the electron distribution function in a microwave field. Experimental verification of the method is presented. (Atomdokumentation, 5: No. 1, Jan. 1963)

36793 CONTRIBUTION TO THE THEORY OF DIFFUSION WAVES IN A PLASMA, STATIONARY IN A LONGITUDINAL MAGNETIC FIELD. V. S. Golubev and V. L. Granovskii. Radio Eng. Electron. (USSR) (English Transl.), No. 4, 624-30(1962).

A theory of diffusion waves, propagating in a gas, located in a longitudinal magnetic field, was developed for a periodically varying concentration of charge carriers in the initial portion of the gas volume. The dependence of the wave number and the attenuation of the diffusion wave on the magnetic field intensity and other conditions was investigated. The observation of such waves can permit the determination, through new methods, of the coefficient of transverse diffusion of charge carriers in a gas located in a magnetic field. (Atomdokumentation, 5: No. 1, Jan. 1963)

36794 BOUNDARY PROBLEM OF THE STATIONARY MAGNETOHYDRODYNAMICS EQUATIONS. Kai-ming Chang. Shu Hsueh Hsueh Pao, 12: 258-65(1962).

The generalized and the classical solutions of a boundary problem are given. With the help of integral identity, the generalized solution is defined, its existence is made sure of, and at the same time the priori estimation of the solution is obtained. Using the Green tensor $G_{ij}(x,y)$ of the Stokes equations and Green tensor $V_{ik}(x,y)$ of the problem rot $\vec{H} = \vec{j}$, div $\vec{H} = 0$, $H_{ns} = 0$, the boundary problem of the magnetohydrodynamics equations is reduced to a system of the nonlinear integral equations. Having applied the fixed point theorem of Leray and Schauder the existence of at least one solution of the system is obtained. A further investigation of the differential property of the solution was also made. Hence, it is proved that the solution is the required classical solution. (OTS)

36795 PROPAGATION OF ELECTROMAGNETIC WAVES IN SEMI-SPACE FILLED WITH PLASMA. Yu. N. Dnestrovskii and D. P. Kostomarov. Vestn. Mosk. Univ., Ser. III, Fiz. Astron., No. 2, 3-8(Mar.-Apr. 1963). (In Russian)

A mathematical analysis was made of electromagnetic waves, propagating across an external magnetic field, in a semi-space filled with plasma. At a certain distance from the plasma boundary, a plane propagating wave was described by the dispersion equation for an infinite plasma. The solution was found as $T \to 0$. (tr-auth)

36796 CALCULATIONS OF LOW PRESSURE PLASMA PARAMETERS IN NEON. N. V. Basova, A. M. Devyatov, G. S. Solntsev, and P. I. Skvortsov. Vestn. Mosk. Univ., Ser. III, Fiz. Astron., No. 2, 37-42(Mar.-Apr. 1963). (In Russian)

Magnitudes of T_e, E_z, and N_1 in a neon incandescent cathode discharge at 0.02 to 0.2 mm Hg were calculated using the Klyarfeld method and considering losses by emission. Correlations of obtained data with probe measurements showed satisfactory agreement. (tr-auth)

36797 DISTRIBUTION OF ELECTRON CONCENTRATION ALONG THE RADIUS OF A POSITIVE COLUMN GAS DISCHARGE. T. A. Sanina and A. A. Sanin. Vestn. Mosk. Univ., Ser. III, Fiz. Astron., No. 2, 43-6(Mar.-Apr. 1963). (In Russian)

The process of electron distribution along the radius of a positive column discharge at low pressure (≈ 1 mm Hg in a 2-cm radius, 50-cm length tube) was evaluated using an optical method. It is shown that the nearly constant radial distribution is established within several microseconds. (tr-auth)

36798 PARTICLE CONTAINMENT BY UNDULATED FIELD CURRENT. R. A. Demirkhanov, T. I. Gutkin, and T. R. Soldátenkov (Inst. of Physics and Tech., Academy of Sciences, Georgian SSR). Zh. Tekhn. Fiz., 33: 544-9(May 1963). (In Russian)

Single-particle motion was analyzed in an undulated magnetic field using drift equations and considering the longitudinal current. It is shown that for given current values, magnetic field modulations, and system periods the particle resonance ($\Delta\varphi = 0$) can be eliminated and particle containment improved. (tr-auth)

36799 STABILITY OF ELECTROMAGNETIC PERTURBATIONS PROPAGATING IN HETEROGENEOUS PLASMA IN TRANSVERSE MAGNETIC FIELD. V. V. Arsenin. Zh. Tekhn. Fiz., 33: 550-4(May 1963). (In Russian)

It is shown that electromagnetic perturbations propagating in heterogeneous rarefied plasma in a transverse magnetic field are stable, contrary to postulations by Pfirsch and Biermann in Zr. Naturforsch., 15A: 14, 1960. (tr-auth)

36800 ON HIGH-FREQUENCY CONDUCTIVITY OF THE POSITIVE PLASMA COLUMN IN A NEON GASEOUS DISCHARGE. A. F. Aleksandrov and A. A. Kuzovnikov (Moscow State Univ.). Zh. Tekhn. Fiz., 33: 555-6(May 1963). (In Russian)

The conductivity of the positive plasma column in a neon gaseous discharge at 0.5 mm Hg pressure was studied as a function of electron concentration (n_e^0) at 28.5 Mc. The conductivity is a linear function of electron concentration up to $n_e^0 \approx 1.2$ to 1.4×10^9 cm^{-3}; with further n_e^0 increase the conductivity ceases to be a linear function. (R.V.J.)

36801 REFLECTION AND REFRACTION OF ELECTROMAGNETIC WAVES ON A MOVING BOUNDARY BETWEEN TWO MEDIA. S. N. Stolyarov (Lebedev Inst. of Physics, Moscow). Zh. Tekhn. Fiz., 33: 565-70(May 1963). (In Russian)

Frenel's formulas were developed for the shock wave front at the tangential boundary between two media. Dispersion properties of moving media and their effects on the reflection and refraction wave intensities are discussed. (tr-auth)

36802 ON THE STABILITY OF A WEAKLY HETEROGENEOUS PLASMA. Yu. N. Dnestrovskii and D. P. Kostomarov (Moscow State Univ.). Zh. Tekhn. Fiz., 33: 625-6 (May 1963). (In Russian)

Stability of a cold weakly heterogeneous plasma ($L \gg \lambda$) in relation to a longitudinal plasma wave perturbation (rot E = 0) was analyzed by hydrodynamic approximation. (R.V.J.)

36803 OSCILLATIONS OF COLD NON-UNIFORM PLASMA IN GRAVITY FIELD. E. E. Lovetskii and A. A. Rukhadze (Lebedev Inst. of Physics, Moscow). Zh. Tekhn. Fiz., 33: 652-9(June 1963). (In Russian)

Equilibrium stability of spatially non-uniform cold magnetic plasma in a gravitational field was investigated. The tensor operation of dielectric penetrability was determined for a two-fluid model of non-colliding plasma. Thermal emission from heterogeneous plasma was analyzed, and an expression was derived for the Poindinger vector. Dispersion equation for heterogeneous plasma electromagnetic oscillations are investigated in geometric optics. Instability conditions and growth increments for magnetic waves were determined, and it is shown that in a gravitational field heterogeneous plasma is unstable in relation to longitudinal drift wave excitations and electromagnetic waves propagating along magnetic fields. (tr-auth)

36804 CONVECTIONAL INSTABILITY OF NON UNIFORM PLASMA IN A GRAVITY FIELD. E. E. Lovetskii and A. A. Rukhadze (Lebedev Inst. of Physics, Moscow). Zh. Tekhn. Fiz., 33: 660-6(June 1963). (In Russian)

Equilibrium stability of weakly non-uniform rarefied magnetic plasma in a gravitational field was investigated considering thermal propagation of particles. In a strong magnetic field a plasma is unstable in relation to convective instability of electromagnetic waves propagating along magnetic lines. (tr-auth)

36805 CURRENT AND HEAT FLOW IN DUAL TEMPERATURE PLASMA. M. V. Samokhin. Zh. Tekhn. Fiz., 33: 667-74(June 1963). (In Russian)

A distribution function approximation was expanded in terms of Hermite polynomials and used for reducing linear kinetic equations to an algebraic system, the roots of the system determining the currents and thermal fluxes in a magnetic field. Numerical transfer coefficients in moving plasma were resolved as thirteen momentum approximations. (tr-auth)

36806 PARTICLE AND HEAT FLUXES IN MULTICOMPONENT PLASMA. M. V. Samokhin. Zh. Tekhn. Fiz., 33: 675-84(June 1963). (In Russian)

Electron and ion distribution function approximations were expanded in terms of Hermite polynomials and used for reducing linearized kinetic equations to an algebraic system; the roots of the system determining currents and thermal fluxes. The numerical coefficients for a three-component plasma moving in a strong magnetic field were resolved as thirteen momentum approximations. (tr-auth)

36807 ENERGY SPECTRA OF ELECTRONS AND IONS EJECTED FROM MAGNETIC MIRRORS. Yu. G. Zubov, E. A. Koltypin, E. A. Lobikov, and A. I. Nastyukha. Zh. Tekhn. Fiz., 33: 686-92(June 1963). (In Russian)

Results of energy spectra measurements on electrons and ions ejected through a magnetic mirror installation with adiabatic plasma compression are described. (tr-auth)

36808 TIME-OF-FLIGHT OSCILLATIONS IN ELECTRON-ION FLUX. E. G. Baksht (Leningrad Inst. of Semiconductors). Zh. Tekhn. Fiz., 33: 693-702(June 1963). (In Russian)

Electron and ion time-of-flight effects in Knudsen plasma were analyzed in one-dimensional approximation. The plasma diode impedance was calculated, and the region of generation was determined. Ion plasma oscillations were accelerated in a given frequency range. (R.V.J.)

36809 COLLISIONAL DISSIPATION IN CYCLOTRON OVERTONES IN PLASMAS. V. P. Demidov and D. A. Frank-Kamenetskii. Zh. Tekhn. Fiz., 33: 703-9(June 1963). (In Russian)

Collision oscillation damping in transverse plasma propagation was estimated near harmonics of electron cyclotron frequencies. It was shown that collisional damping in a sufficiently hot and dense plasma is strongly amplified due to spatial dispersion near electron cyclotron harmonics. (tr-auth)

36810 STRONG PLASMA EMISSION IN A STRONG MAGNETIC FIELD. V. V. Matveev, A. D. Sokolov, and L. A. Suchkova. Zh. Tekhn. Fiz., 33: 710-14(June 1963). (In Russian)

Strong x-ray and neutron emissions from plasma were studied using a Tokamak-2 installation. Measurements of x-ray emission were taken as functions of initial deuterium pressure and intensity of confining and heating fields. The experiments showed that x-ray emission was a direct function of heating and trapping field intensities. Moreover, x-ray emission and distribution depend also on the electron direction in the installation. X ray yields from deuterium hydrogen and helium were almost identical, while for argon the yields are different. The highest mean x-ray energies were obtained from hydrogen and deuterium. The mean energy from helium was a little lower; and the lowest came from 600 to 800 kev. The number of neutrons emitted per charge was less than 10^4 without x radiation and less than 10^5 with it. (R.V.J.)

36811 PROPERTIES OF CONVERGING PLASMA JETS IN INDUCTION DISCHARGE. K. V. Suladze and A. A. Plyutto. Zh. Tekhn. Fiz., 33: 715-18(June 1963). (In Russian)

Plasma jet collisions were studied in a installation constructed such that six jets converged to the center. Photographs and magnetic probe measurements are given. The converging jets are trapped by magnetic fields, producing annular currents that stabilize the final plasma. (tr-auth)

36812 ON THE DIPOLE ABOVE A GYROTROPIC MEDIUM. D. N. Chetaev. Zh. Tekhn. Fiz., 33: 745-7 (June 1963). (In Russian)

Equations were developed for electromagnetic potentials of vertical dipole fields in a free space above the boundary of a vertically magnetized gyrotropic medium. Electric and magnetic dipoles above magnetic plasma were analyzed, and the results were applied to a gyromagnetic medium. An approximate solution for the field in a vacuum above an absorbing gyrotropic medium was solved previously by means of generalized boundary conditions. The suggested solution can be applied to the total space in the absence of absorption. (tr-auth)

36813 ON ONE TYPE OF NON-LINEAR SOLUTIONS FOR KINETIC EQUATIONS WITHOUT COLLISION INTEGRALS. F. M. Nekrasov. Zh. Tekhn. Fiz., 33: 769-75 (July 1963). (In Russian)

The problem of stable, one-dimensional, nonlinear electron-ion plasma motion in a self-consistent magnetic field was analyzed. Two types of kinetic equations were developed, assuming Maxwell distribution of velocities. In the first case the field was assumed to be a transverse wave moving at a constant rate; the longitudinal field was zero. In the second case the waves (isolated pulses) propagate with a constant rate equal to the plasma motion in the absence of a magnetic field. The latter case can be resolved with or without electric field along the propagation. Two solutions, both without longitudinal field, were developed for the density distribution, plasma fluxes, and magnetic field. One solution is fitted for a periodic distribution of magnetic field and the other for plasma pinch. Both problems are reduced to a coordinate system in which the phase wave rate is zero. (R.V.J.)

36814 ON CONVECTION OF WEAKLY IONIZED PLASMA IN INHOMOGENEOUS EXTERNAL MAGNETIC FIELDS. A. V. Temofeev. Zh. Tekhn. Fiz., 33: 776-81 (July 1963). (In Russian)

An analysis was made of laminar convection developed in a weakly ionized plasma in a strong heterogeneous magnetic field. A supplementary plasma flux developed by the oscillations along the density gradient was calculated in quasi linear approximation. (tr-auth)

36815 VISCOSITY IN RELATIVISTIC MAGNETOHYDRODYNAMICS. G. M. Zaslavskii and S. S. Moiseev (Novosibirsk State Univ., USSR). Zh. Tekhn. Fiz., 33: 782-7(July 1963). (In Russian)

The viscosity tensor for a relativistic gas in magnetohydrodynamics was developed using kinetic equations and calculations similar to Grad's method. The obtained viscosity coefficients are used for determining the stability of collisionless relativistic plasma in a magnetic field when considerations for magnetic viscosity are identical to those for a finite Larmor radius. The investigation also included perturbations from distorted magnetic lines. (R.V.J.)

36816 NATURAL OSCILLATIONS OF ELLIPSOIDAL PLASMA IN CONSTANT MAGNETIC FIELD. Yu. A. Berezin. Zh. Tekhn. Fiz., 33: 788-94(July 1963). (In Russian)

Heterogeneous resonance frequencies are generalized for the case of a plasma ellipsoid with a homogeneous magnetic field along its axis. A quasi-statistical approximation of natural oscillation spectra was developed using the Walker method (Phys. Rev., 105: 390, 1957) and a dielectric penetrability tensor with a different frequency function than that used by Walker for the magnetic tensor. (R.V.J.)

36817 FRONT STRUCTURE STABILITY FOR SHOCK WAVES PROPAGATING ACROSS A MAGNETIC FIELD IN RAREFIED PLASMA. V. I. Karpman and R. S. Sagdeev (Novosibirsk State Univ., USSR). Zh. Tekhn. Fiz., 33: 805-14(July 1963). (In Russian)

Stability of small amplitude shock waves in rarefied plasma was studied, and the oscillation structure for instability was indicated. (tr-auth)

36818 ON THE THEORY OF THE STATIONARY STATE OF HIGH-TEMPERATURE PLASMA AND PLASMOIDS WITH LONGITUDINAL MAGNETIC FIELDS. E. F. Tkalich and V. S. Tkalich. Zh. Tekhn. Fiz., 33: 815-19(July 1963). (In Russian)

Kinetic equations were developed for stationary high-

temperature plasma with arbitrary symmetry. Density, velocity, and other macroscopic physical magnitudes were found for a plasma pinch and for plasma in thin-walled tubes. (R.V.J.)

36819 ON THE THEORY OF ELECTRODYNAMIC ACCELERATION OF PLASMA BUNCHES IN A COAXIAL ACCELERATOR. N. A. Khizhnyak and P. M. Kolesnikov (Khar'kov Inst. of Aviation). Zh. Tekhn. Fiz., 33: 820-2 (July 1963). (In Russian)

Nonlinear differential equations were derived for describing the acceleration of ideally conducting plasma bunches in a coaxial accelerator with $v \ll C$. A circuit diagram for a coaxial accelerator for plasma is included. (R.V.J.)

36820 INVESTIGATION OF PLASMA CONTAINMENT IN A MAGNETIC TRAP WITH OPPOSING FIELDS. B. P. Kononov. Zh. Tekhn. Fiz., 33: 835-8(July 1963). (In Russian)

Plasma containment in a trap with alternating peak-configuration magnetic field was investigated for the case in which the field penetrates the plasma. Experimental data are given on the density distribution and luminescence of the trapped plasma. The observed density variations are analyzed within the limits of magnetohydrodynamic theory. (tr-auth)

36821 CONTAINMENT OF ANNULAR HIGH-FREQUENCY DISCHARGE BY GROWING MAGNETIC FIELDS. M. D. Raizer (Lebedev Inst. of Physics, Moscow). Zh. Tekhn. Fiz., 33: 839-42(July 1963). (In Russian)

Containment of annular high-frequency plasma currents (6 to 360 Mc) by a slowly increasing (10 kc) magnetic field results in a plasma configuration isolated, within a few microseconds, from the walls of the discharge chamber. (tr-auth)

36822 EFFECTS OF COLLISIONS ON ELECTRON LOCALIZATION IN HIGH-FREQUENCY FIELD. Ya. M. Pinskii (Ioffe Inst. of Physics and Tech., Leningrad). Zh. Tekhn. Fiz., 33: 864-6(July 1963). (In Russian)

Effects of electron-atom collisions on plasma confinement in high-frequency fields were studied. It is shown that stabilized confinement is possible only with sufficiently steep walls in potential wells. Stationary electron temperature was determined. (tr-auth)

36823 EFFECTS OF PRE-ELECTRODE REGIONS ON THE ELECTRIC CONDUCTIVITY OF WEAKLY IONIZED PLASMA. E. B. Sonin. Zh. Tekhn. Fiz., 33: 872-81 (July 1963). (In Russian)

Plasma conductivity was estimated between plane electrodes of identical temperature and yield. In addition to a term describing the grad $\underline{d}$, the developed expression is equipped with a correction factor for the influence of pre-electrode regions. The correction factor is not a function of the barrier in cases where the plasma boundary presents a barrier to electrons emitted by metals. The constant in the conductivity expression for the barrier to electrons emitted by plasma increased as the barrier increased. (tr-auth)

36824 PULSED ELECTROMAGNETIC ACCELERATION OF METAL PLASMAS. T. L. Rosebrock, D. L. Clingman, and D. G. Gubbins (General Motors Corp., Indianapolis). New York, American Inst. of Aeronautics and Astronautics, 1963, Preprint 63-163, 13p, $1.00. (CONF-97-13)

From Summer Meeting, Los Angeles, June 1963.

Theoretical and experimental proof-of-principle studies and component tests on a pulsed plasma accelerator are described. The experimental accelerator currently approaching operational status is predicated on a power availability of 25 kw into the capacitor. Design goals for the accelerator are 50% efficiency at 3.5×10^4 m/sec velocity and 0.7 newtons of thrust at 100 pulses/sec. The physical arrangement of electrodes and transport is shown. The propellant wheel is machined from lava, heat treated and glazed on the outer surface, with a diameter of 0.2 m. Brass electrodes, spaced 0.04 m at the wheel surface, will be used for initial tests. The propellant boiler will be an insulated cylinder heated by resistance wires wrapped around the periphery. (A.G.W.)

36825 RECENT RESULTS OF STUDIES OF THE TRAVELING WAVE PUMP. Eugene E. Covert, Laurence R. Boedeker, and Charles W. Haldeman (Massachusetts Inst. of Tech., Cambridge). New York, American Inst. of Aeronautics and Astronautics, 1963, Preprint 63-281, 13p. $1.00. (CONF-97-9)

From Summer Meeting, Los Angeles, June 1963.

Recent studies of the traveling wave pump emphasize the possibility of increasing Mach number and increasing velocity during the acceleration process. A simple analytical model of the process is developed from the basic equations by averaging overtime and wavelength to arrive at a one-dimensional form. It is shown that the one-dimensional model can include the influence of the magnetic field on the conductivity. Results of integration of the basic one-dimensional equations are presented. The kind of experimental data needed to verify or deny the usefulness of these simple equations is discussed. (A.G.W.)

36826 VELOCITY LIMITATION OF A COAXIAL PLASMA GUN. K. Thom, J. Norwood, and N. Jalufka (Langley Research Center, Hampton, Va.). 13p. (CONF-93-1)

From International Symposium on Coaxial Plasma Gun, Cleveland, Sept. 1962.

The current in a coaxial plasma gun is associated with the impact of ions on the cathode, and the current is proportional to the rate of ion impacts. By the assumption that each impact results in the loss of the longitudinal momentum of the particle, a friction force of the plasma with the walls is established. An evaluation of the momentum equation, including this friction force exhibits a limiting velocity of the plasma. For characteristic parameters of coaxial plasma guns the limiting velocity is in good agreement with observed plasma velocities. It is expected that the simultaneous solution of the power equation and the momentum equation, including the friction force, will yield the principles of most efficient acceleration. For a practical coaxial plasma accelerator, the velocity limit due to friction at the walls is much less than the limiting E/B drift velocity. (auth)

36827 GAS PHASE AND SURFACE PHENOMENA OBSERVED WITH A SEEDED PLASMA. A. C. Pinchak and E. E. Zukoski (California Inst. of Tech., Pasadena). 7p. (CONF-24-8)

From Engineering Aspects of Magnetohydrodynamics Symposium, Berkeley, Calif., Apr. 1963. Available: ORINS. Gmelin, AED-CONF-63-030-7.

Two modes of steady conduction were found for current flow between high-temperature electrodes in a potassium-seeded argon plasma. In both modes, electron emission from the cathode is apparently by the thermionic process, and steady current densities over 200 amps/cm^2 were obtained with tungsten electrodes operating at average temperatures of 1700°K. In the normal mode, current density

is less than the thermionic limit and cathode sheath potentials are less than a few (kT_w). In the second mode, current density is equal to the thermionic limit and sheath potentials are much larger than (kT_w). Heat transfer phenomena are dominated by the electron cooling or heating effects. In the normal mode, the most important term appears to be the energy loss or gain associated with the motion of electrons through the surface work function barrier. In the current-limited mode, sheath effects are dominant. Convective heat-transfer rates in the normal mode increase slowly with current density and appear to be two to three times the zero current values. Interpretation of current-voltage data indicates that both Joule heating and some non-equilibrium process must be taken into account to explain the high conductivity values observed experimentally. (auth)

36828 STABILITY CRITERIA FOR A PLASMA. T. K. Fowler. 10p. (CONF-78-2)

From American Physical Society Meeting, Buffalo, June 1963.

Plasma stability criteria obtained from the linearized Vlasov equation are reviewed. The role of constants of motion is emphasized. It is shown that known stability criteria in infinite plasmas can be obtained from conservation laws of particle dynamics. It seems unlikely that the results are consequences only of idealizing the plasma. Limitations imposed on the plasma as a whole by known integrals of plasma dynamics, which are constant or nearly constant, are considered. Bounds on growth rates of magnetically confined plasmas are obtained. The correspondence of these bonds with growth rates predicted in the idealized cases suggests that no instability modes faster than known modes have been overlooked. (A.G.W.)

36829 PLASMA BEHAVIOR IN AN OSCILLATING-ELECTRON ION ENGINE. J. W. Davis, A. W. Angelbeck, and E. A. Pinsley (United Aircraft Corp., East Hartford, Conn.). New York, American Institute of Aeronautics and Astronautics, 1963, Preprint 63003-63, 13p. (CONF-10-50)

From Electric Propulsion Conference, Colorado Springs, Colo., Mar. 1963.

Results of an experimental investigation of the effects of external operating parameters on both steady-state and transient plasma behavior in the engine environment are reported. Parameters studied included anode voltage, anode current, magnetic field strength, and mass flow. Measurement of axial plasma potential gradients was emphasized. Under certain conditions the engine exhibited a cyclic on-and-off type of operation. There was evidence that this fluctuating mode of operation was caused by the pumping action of the engine. Rotation of the plasma within the engine was also observed. (A.G.W.)

36830 NUCLEAR FUSION REACTORS WITH ANNULAR PINCH DISCHARGE AND THE METHODS OF OPERATING THEM. (to Brown, Boveri & Cie AG and Beteiligungs- und Patentverwaltungesellschaft mit Beschankter Haftung). British Patent 932,954. July 31, 1963. Priority date Dec. 23, 1958, Germany.

A method of operating a thermonuclear reactor having an annular pinch discharge is patented. The gas discharge is contracted by its own magnetic field, and the energy required for the gas discharge is generated by discharging an inductive accumulator. The primary coil of an intermittently operating transformer is used as the accumulator, and the annular gas discharge forms the secondary winding. A second transformer is provided between the d-c source and the first transformer. The primary winding of the second transformer is short-circuited when the current in the primary of the first transformer is a maximum. The current in the primary of the first transformer is switched off by switching the current through a resistance. Details of the construction of the switching devices are described. (M.P.G.)

36831 PLASMA GENERATOR. John M. Wilcox and W. R. Baker (to U. S. Atomic Energy Commission). U. S. Patent 3,104,345. Sept. 17, 1963.

This invention is a magnetohydrodynamic device for generating a highly ionized ion-electron plasma at a region remote from electrodes and structural members, thus avoiding contamination of the plasma. The apparatus utilizes a closed, gas-filled, cylindrical housing in which an axially directed magnetic field is provided. At one end of the housing, a short cylindrical electrode is disposed coaxially around a short axial inner electrode. A radial electrical discharge is caused to occur between the inner and outer electrodes, creating a rotating hydromagnetic ionization wave that propagates along the magnetic field lines toward the opposite end of the housing. A shorting switch connected between the electrodes prevents the wave from striking the opposite end of the housing. (AEC)

Shielding

Refer also to abstracts 35333, 36033, and 36347.

36832 (AD-291133) SOME APPLICATIONS OF A SEMIEMPIRICAL FORMULA FOR DIFFERENTIAL DOSE ALBEDO FOR GAMMA RAYS ON CONCRETE. W. C. Ingold (Naval Civil Engineering Lab., Port Hueneme, Calif.). Nov. 30, 1962. 23p. (TN-469)

A formula by Chilton and Huddleston has been used to develop computer programs for calculating differential dose albedo, the first reflection contribution to the dose rate in round and square ducts, and the second reflection contribution to the dose rate in a cylindrical duct. The program listings are included, and results obtained with them (including a comparison of dose rates in round and square ducts) are given.

36833 (HW-71113) SHIELDING PROPERTIES OF AS-CURED BARITE CONCRETE. C. L. Bennett (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Sept. 20, 1961. Contract AT(45-1)-1350. 28p.

The fast neutron attenuation was found to be approximately exponential. The measured relaxation lengths of barite concrete in the as-cured condition are respectively 10.55, 10.65, and 11.69 cm. This difference in relaxation lengths was attributed to the water loss (0.07 gm/cm^3) that occurred while the barite concrete was in the test wells, the water being driven off by heat absorbed from the thermal shield. In the first test a measured fast neutron removal cross section of 0.0892 cm^{-1} was obtained for a concrete density of 3.55 gm/cm^3. This value agrees within about 7 per cent with the calculated removal cross section of 0.0831 cm^{-1}. In the last test the variation between experimental and calculated values was about 6 per cent. These variations can be attributed largely to uncertainties in the composition of the concrete. (auth)

36834 (TRG-Report-573) ON THE CAPTURE PROBABILITY OF RADIATION IN A FINITE ROD. R. I. McLeod (United Kingdom Atomic Energy Authority. Reactor Group, Dounreay, Caithness, Scotland). June 7, 1963. 16p.

The basic mathematical equations to calculate the capture probability of radiation in a finite cylindrical rod are expressed in a form directly applicable to any absorption law in which the radiation absorbed per unit volume depends only on the distance from the source to the point of absorption. An Autocode program was written for the MERCURY computer to calculate the capture probabilities for length-to-diameter ratios of 1 to 10 in unit steps. A sub-sequence specifying the absorption law must be supplied by the user. Values of the capture probabilities were obtained for the absorption law $\mu\exp(-\mu r)/4\pi r^2$ where μ is the absorption coefficient. Results are quoted for cylinders of diameters in mean free paths ranging from 0.001 to 20. The Autocode program has been given the Dounreay Library Programme number 219. (auth)

36835 ISPRA JOINT RESEARCH CENTER IN THE FIELD OF SHIELDING. A. Kind and R. Nicks (Euratom, Ispra, Italy). 16p. (CONF-144-1; EUR 233.i). (In French)

From Gionnate dell'Energia Nucleare Proceedings, Milan, Dec. 1962.

Experimental and theoretical research on the propagation of neutrons and gamma rays by ducts in shielding and on monoenergetic neutron attenuation is reported. Preliminary results are included. (D.C.W.)

Theoretical Physics

36836 FREDHOLM METHOD IN POTENTIAL SCATTERING AND APPLICATIONS TO COMPLEX ANGULAR MOMENTUM. Lowell Brown (Imperial Coll. of Science and Tech., London), Daniel I. Fivel, Benjamin W. Lee, and Raymond F. Sawyer. Ann. Phys. (N. Y.), 23: 187-220(Aug. 1963).

A formulation of the complex angular momentum in potential scattering, based on the Lippman-Schwinger integral equation rather than on the Schrödinger equation, is described. Formulas are derived which formally express wave functions and scattering amplitudes as N/D solutions of Fredholm integral equations. (R.E.U.)

36837 QUANTUM THEORY OF TRANSPORT COEFFICIENTS. [PART] II. K. Baumann (Universitet, Vienna). Ann. Phys. (N. Y.), 23: 221-32(Aug. 1963).

The method of thermal Green's functions is applied to a lowest order calculation of different transport coefficients. This is the first step of a systematic approach intended to replace the use of the Boltzmann equation. (auth)

36838 REGGE CUTS AND THREE-PARTICLE STATES IN A NONRELATIVISTIC MODEL. I. T. Drummond (Cavendish Lab., Cambridge, Eng.). Ann. Phys. (N. Y.), 23: 284-303(Aug. 1963).

An examination of the effects of three-particle states on analyticity properties in the complex angular momentum plane in a simple nonrelativistic model is given. The partial wave equations of the model are prototypes for the equations governing a Schrödinger many-body problem when cast in multichannel form. It is found that if these equations are used to make the angular momentum, l, complex then energy dependent branch points in the l-plane are obtained. These singularities are the reflections of angular momentum dependent thresholds in the energy plane. (auth)

36839 CONDITIONS FOR FLATNESS IN GENERAL RELATIVITY. R. Arnowitt and S. Deser (Brandeis Univ., Waltham, Mass.). Ann. Phys. (N. Y.), 23: 318-29(Aug. 1963).

In the absence of sources, the Einstein field equations, $R_{\mu\nu} = 0$, may be thought of as defining a special class of Riemann spaces whose twenty curvature components $R_{\mu\nu\alpha\beta}$ have ten vanishing linear combinations; $R_{\mu\nu} = 0$. The necessary and sufficient criterion for the absence of a gravitational field is that space-time be flat, namely, that the curvature tensor vanish: $R_{\mu\nu\alpha\beta} = 0$. The conditions for such a flatness in general relativity are discussed primarily and several flatness theorems are derived. (R.E.U.)

36840 ASYMPTOTIC WAVE VECTOR AND NONRELATIVISTIC PERTURBATION THEORY. S. Teitler (Naval Research Lab., Washington, D. C.). J. Math. Phys. (N. Y.), 4: 1119-27(Sept. 1963).

The dual nature of perturbations in causing both transitions and persistent effects is investigated. A wave vector initially represented in terms of a set of unperturbed eigenvectors is subjected to a nondissipative perturbation. After a long time, it is assumed that this unperturbed wave vector evolves into an asymptotic wave vector in which both persistent and transition effects are present. These two effects are considered separately and the asymptotic wave vector is formally expressed as an expansion in terms of asymptotically stationary states. A time-operator form of nonrelativistic perturbation theory which formally is very similar to the resolvent formalism is presented. In a manner similar to the resolvent formalism, diagonal and nondiagonal contributions to the development operator are considered separately. A further classification of the development operator into asymptotic and nonasymptotic parts is made. This latter form is used to obtain an explicit form for the asymptotic wave vector, and the asymptotically stationary states are identified. (auth)

36841 BASES FOR THE IRREDUCIBLE REPRESENTATIONS OF THE UNITARY GROUP AND SOME APPLICATIONS. Marcos Moshinsky (Universidad de Mexico, Mexico City). J. Math. Phys. (N. Y.), 4: 1128-39(Sept. 1963).

It is shown that sets of polynomials in the components of (2j + 1)-dimensional vectors, solutions of certain invariant partial differential equations, form bases for all the irreducible representations of the unitary group U_{2j+1}. These polynomials will play, for the group U_{2j+1}, the same role that the solid spherical harmonics (themselves polynomials in the components of a three-dimensional vector) play for the rotation group R_3. With the help of these polynomials the reduced Wigner coefficients for the unitary groups are defined and determined, and are then used to derive the Wigner coefficients of U_{2j+1} by a factorization procedure. An ambiguity remains in the explicit expression for the Wigner coefficients as the Kronecker product of two irreducible representations of U_{2j+1} is not, in general, multiplicity-free. It is shown how to eliminate this ambiguity with the help of operators that serve to characterize completely the rows of representations of unitary groups for a particular chain of subgroups. The procedure developed to determine the polynomial bases of U_{2j+1} seems, in principle, generalizable to arbitrary semisimple compact Lie groups. (auth)

36842 SPIN-COMPONENT ANALYSIS OF SINGLE-DETERMINANT WAVEFUNCTIONS. Fukashi Sasaki and Kimio Ohno (Uppsala Univ.). J. Math. Phys. (N. Y.), 4: 1140-7(Sept. 1963).

The weights of spin components involved in a single-determinant wave function are obtained. The behavior of the weights for a system of a large number of electrons is discussed. (auth)

36843 AN EXACTLY SOLUBLE MODEL OF A MANY-FERMION SYSTEM. J. M. Luttinger (Columbia Univ., New York). J. Math. Phys. (N. Y.), 4: 1154-62(Sept. 1963).

An exactly soluble model of a one-dimensional many-fermion system is discussed. The model has a fairly realistic interaction between pairs of fermions. An exact calculation of the momentum distribution in the ground state is given. It is shown that there is no discontinuity in the momentum distribution in this model at the Fermi surface, but that the momentum distribution has infinite slope there. Comparison with the results of perturbation theory for the same model is also presented, and it is shown that, for this case at least, the perturbation and exact answers behave qualitatively alike. The response of the system to external fields is also discussed. (auth)

36844 RELATIVISTIC KINETIC THEORY OF A SIMPLE GAS. W. Israel (Univ. of Alberta, Edmonton). J. Math. Phys. (N. Y.), 4: 1163-81(Sept. 1963).

A consistent relativistic theory of transport processes in a simple gas is developed. The approach is the four-dimensional geometric one due to Synge. Scalar and vector eigenfunctions of the linearized collision operator are derived when the scattering cross section is a simple separable function of scattering angle and relative velocity (Maxwellian particles). The bulk viscosity and thermal conductivity are computed explicitly for this case. (auth)

36845 KINETIC EQUATIONS FOR ELECTRONS AND PHONONS. Amiram Ron (Princeton Univ., N. J.). J. Math. Phys. (N. Y.), 4: 1182-90(Sept. 1963).

A method is presented for deriving a set of kinetic equations for a system of electrons and phonons in a simplified model of a metal. By employing the second quantization representation for the creation and annihilation operators of the electrons and the phonons, an hierarchy of equations for the distribution functions and correlation functions is introduced. This hierarchy is studied, using an approach originally developed by Bogoliubov, where both truncation of the hierarchy and irreversibility are achieved under general assumptions. A set of kinetic equations is obtained for an homogeneous system, where the electrons dynamically shield both each other and the phonons. (auth)

36846 THE NUMBER OF DISTINCT SITES VISITED IN A RANDOM WALK ON A LATTICE. George H. Vineyard (Brookhaven National Lab., Upton, N. Y.). J. Math. Phys. (N. Y.), 4: 1191-3(Sept. 1963). (BNL-6853)

A general formalism is developed from which the average number of distinct sites visited in n steps by a random walker on a lattice can be calculated. The asymptotic value of this number for large n is shown to be $(8n/\pi)^{1/2}$ for a one-dimensional lattice and cn for lattices of three or more dimensions. The constant c is evaluated exactly, with the help of Watson's integrals, for the simple cubic, body-centered cubic, and face-centered cubic lattices. An analogy is drawn with an electrical network in which unit resistors replace all near-neighbor bonds in a lattice, and the resistance of such a network on each of the three cubic lattices is evaluated. (auth)

36847 OBSERVABLE PROPERTIES OF LARGE RELATIVISTIC MASSES. A. W. K. Metzner (Cornell Univ., Ithaca, N. Y.). J. Math. Phys. (N. Y.), 4: 1194-1205(Sept. 1963).

Interstellar space may be full of very dense and very faint stars (supernova remnants, very old white dwarfs, etc.), on whose surfaces the gravitational field intensity is very high. What, according to general relativity, are their observable properties, and what are the maximum gravitational effects as a matter of principle? To answer this the exact test particle orbits (geodesics) of the Schwarzschild metric are derived, classified, and described on the basis of an exact classical model. The latter is of considerable help in making the properties of the orbits immediately evident, and represents the principal advantage of the present derivation over previous ones. Also, as radial coordinate, instead of the usual largely arbitrary r, the metric coefficient $g_{00} = A^2(r)$ is used. A^2 has immediate physical significance as the red shift ratio $\nu(r)/\nu(\infty)$, and its use also simplifies the formulas. The test-particle scattering angle (generalizing the results of Darwin), and the differential scattering cross section, as well as the capture cross section of a sphere of radius $A^2(r) = A^2(R) = A_R^2$, are calculated as a function of test-particle energy, and presented graphically. The observed, augmented, angular diameter of a sphere is calculated in terms of A_R^2, and some peculiar lenslike effects of masses, first discussed by Einstein, are reviewed. It is then pointed out that an important result of Curtis for the interior field, implies $A_R^2 > 0.514$, so that the exterior field extends at most down to $A^2 = 0.514$, and the region $A^2 < 0.514$—which would be the most pathological region of the exterior—cannot in fact exist, if Curtis arguments are assumed valid. As a result, quasihyperbolic test-particle orbits exist with pericentrum equal to the radius of any conceivable spherical mass, and the radius can therefore in principle always be determined by an asymptotic scattering experiment. As a further result, the maximum photon-scattering angle can be no more than about 110°(and larger for slower particles), providing a cutoff at this point in the photon-scattering cross section, and allowing a massive star to produce at most one secondary image of another star. As a practical matter, none of the effects discussed here seems large enough to be measurable today, with the sole well-known exception of the red shift, which for the Curtis limiting sphere would be large enough to shift a visible spectrum into the near infrared. (auth)

36848 RAY PATHS IN A ROTATING SYSTEM. R. C. Jennison (Univ. of Manchester, Cheshire, Eng.). Nature, 199: 739-41(Aug. 24, 1963).

Light paths through a rotating system were examined using a hypothetical synchrotron machine in which self-luminous particles were orbiting at velocities closely approaching the velocity of light in an outer ring and at progressively slower speeds in a series of smaller concentric rings. It was concluded that the curvature of the ray is a function only of the spin or angular velocity, that different paths are taken by the light to and from any pair of points in the rotating system, that the time-independent or direct radius differs from the action or ray distance, and that it should be possible to determine absolute rotation by measuring the divergence of the paths in opposing directions. (C.H.)

36849 UPPER AND LOWER BOUNDS ON SCATTERING MATRIX ELEMENTS FOR COMPLEX SYSTEMS. L. M. Delves (Univ. of New South Wales, Kensington, Australia). Nucl. Phys., 45: 443-8(Aug. 1963). (In English)

A method is given for determining upper and lower bounds on the scattering matrix elements for arbitrarily complex systems. The method requires only a single trial function and does not involve the solution of any associated problem. The potentials need not be truncated and the bounds obtained are variational in character. (auth)

36850 CONVERGENCE OF BORN SERIES AND THE EXISTENCE OF BOUND STATES. R. Huby (Univ. of Liverpool). Nucl. Phys., 45: 473-80(Aug. 1963). (In English)

The various Born series associated with the scattering of a particle by a central potential V(r) are surveyed. The relation between convergence of these series for all values of the variables concerned, on the one hand, and the existence of bound states in the potentials $-|V|$, V or $-V$, on the other, is investigated. (auth)

36851 GAUGE INVARIANCE AND INTEGRATION RULES. F. C. Khanna and F. Rohrlich (Univ. of Iowa, Iowa City). Phys. Rev., 131: 2721-3(Sept. 15, 1963).

The Feynman-Dyson rules of integration for the scattering matrix elements in perturbation expansion have long been known to lead to gauge-variant results in the case of certain closed loop diagrams. It is shown that a more careful integration, which avoids unjustified interchanges of integrations and limiting processes, keeps the theory gauge-invariant throughout, without the need of explicit cutoffs or appeal to invariance for the specification of undefined integrals. The Feynman-Dyson rules can thus easily be amended to assure gauge invariance. (auth)

36852 ELECTROMAGNETIC TWO-BODY PROBLEM. A. Schild (Univ. of Texas, Austin). Phys. Rev., 131: 2762-6(Sept. 15, 1963).

The circular motion of two classical point charges interacting through their time-symmetric electromagnetic fields is determined with complete relativistic rigor. Expressions are obtained for the total energy and angular momentum of this two-body system, which include the contributions of the field. This work is a preliminary to a calculation, undertaken jointly with Schlosser and now in progress, of the relativistic electromagnetic interaction of two classical particles with charge, spin, and magnetic moment, and of the quantization of this classical two-body system. The purpose of the investigation is to check the possibility that some elementary particles may be atoms composed of other elementary particles in states where the principal interaction is due, not to the Coulomb force between point charges, but to forces where the intrinsic magnetic moments of the particles play an essential role and must not be considered as small perturbations. A very rough, but very simple, estimate by Corben indicates that this possibility is worth exploring. (auth)

36853 COHERENT AND INCOHERENT STATES OF THE RADIATION FIELD. Roy J. Glauber (Harvard Univ., Cambridge, Mass.). Phys. Rev., 131: 2766-88(Sept. 15, 1963).

Methods are developed for discussing the photon statistics of arbitrary radiation fields in fully quantum-mechanical terms. In order to keep the classical limit of quantum electrodynamics plainly in view, extensive use is made of the coherent states of the field. These states, which reduce the field correlation functions to factorized forms, are shown to offer a convenient basis for the description of fields of all types. Although they are not orthogonal to one another, the coherent states form a complete set. It is shown that any quantum state of the field may be expanded in terms of them in a unique way. Expansions are also developed for arbitrary operators in terms of products of the coherent state vectors. These expansions are discussed as a general method of representing the density operator for the field. A particular form is exhibited for the density operator which makes it possible to carry out many quantum-mechanical calculations by methods resembling those of classical theory. This representation permits clear insights into the essential distinction between the quantum and classical descriptions of the field. It leads, in addition, to a simple formulation of a superposition law for photon fields. Detailed discussions are given of the incoherent fields which are generated by superposing the outputs of many stationary sources. These fields are all shown to have intimately related properties, some of which have been known for the particular case of blackbody radiation. (auth)

36854 ASYMPTOTIC SOLUTION OF THE DIRAC EQUATION. S. I. Rubinow (Stevens Inst. of Tech., Hoboken, N. J.) and Joseph B. Keller. Phys. Rev., 131: 2789-96(Sept. 15, 1963).

The WKB method is applied to solve the Dirac equation and the modified Dirac equation appropriate to a spin-½ particle with an anomalous magnetic moment. The solution consists of a phase factor multiplied by a spinor amplitude which is a power series in Planck's constant. The phase is a solution of the Hamilton-Jacobi equation of relativistic mechanics for a spinless particle without electric or magnetic moments. Each term in the spinor amplitude satisfies an ordinary differential equation along the relativistic trajectories. The equation for the leading amplitude yields an equation for the polarization four-vector which is identical with that derived classically by Bargmann, Michel, and Telegdi. It also yields the law of conservation of probability in a tube of trajectories. In addition, it gives rise to an equation for a supplementary phase factor. By using the classical Hamilton-Jacobi function, the law of probability conservation, the polarization four-vector and the supplementary phase factor, the leading term in the solution of the Dirac or modified Dirac equation can be constructed. This solution should be useful when the wavelength of the particle is small compared to the characteristic distance associated with the electromagnetic potential through which the particle moves. When applied to the bound states of a particle without an anomalous moment in a spherically symmetric electrostatic potential, it yields the same results as are usually obtained by separation of variables and use of the ordinary WKB method. The advantage of the present method is that it applies equally well to nonseparable problems. (auth)

36855 QUANTUM VIRIAL EXPANSION. Felix T. Smith (Stanford Research Inst., Menlo Park, Calif.). Phys. Rev., 131: 2803-4(Sept. 15, 1963).

The usual quantum mechanical cluster expansion in the theory of imperfect gases involves the trace of operators of the form $\exp(-H_n/kT)$, where H_n is the n-body Hamiltonian. It is shown that this expansion is identical with the recently derived cluster expansion in terms of the collision lifetime matrices $Q_n(E)$, in which the characteristic terms involve the expressions $\mathrm{Tr}\,[\exp(-E/kT)Q_n(E)]$. (auth)

36856 REMARKS ON THE ANALYTIC CONTINUATION OF THE PARTIAL-WAVE AMPLITUDE. Haridas Banerjee (Carnegie Inst. of Tech., Pittsburgh). Phys. Rev., 131: 2810-17(Sept. 15, 1963).

The asymptotic properties of a certain function F(s,l) relevant to the problem of analytic continuation of the partial wave amplitude T(s,l) is considered by the N/D method. As a function of s, F(s,l) is defined to have only the left-hand ($0 \geq s \geq -\infty$) discontinuity of T(s,l). A representation for F(s,l), suitable for discussing its asymptotic properties, is obtained. It is shown that for large l, F(s,l) must fall off at least as fast as $|l|^{-\frac{1}{2}}$ if s is above threshold. By virtue of crossing symmetry, the s-asymptotic behavior of the left-hand discontinuity is related to the behavior of $A_t(s,t)$, the absorptive part of the scattering amplitude in the t channel, as s and/or t tend to infinity. If $A_t(s,t)$ is bounded by t^α for fixed s, then, under certain assumptions, it is possible to show that F(s,l) is bounded by s^γ where γ is the larger of $(\alpha-1-1, -1)$. A more stringent bound on the asymptotic behavior of F(s,l), although not ruled out, can be established only if one knows the detailed structure of $A_t(s,t)$.

It is suggested that in the absence of crossing symmetry, e.g., in potential scattering, the left-hand discontinuity may behave asymptotically as stipulated by Mandelstam so that analytic continuation of T(s,l) by the N/D method would be possible. (auth)

36857 SPATIAL SEPARATION OF EVENTS IN S-MATRIX THEORY. M Froissart (CEN, Saclay, France), M. L. Goldberger, and K. M. Watson. Phys. Rev., 131: 2820-6(Sept. 15, 1963). (UCRL-10776)

Just as the derivative of the argument of the S matrix with respect to energy gives a time interval for events, it is shown that the corresponding derivative with respect to momentum transfer gives a space interval. This space interval corresponds to the classical impact parameter in the classical limit. More generally, it is suggested that these two derivatives may provide a basis for introducing space-time intervals into physical theory. (auth)

36858 DISSIPATION IN QUANTUM MECHANICS. THE TWO-LEVEL SYSTEM. I. R Senitzky (Army Electronics Research and Development Lab., Fort Monmouth, N. J.). Phys. Rev., 131: 2827-38(Sept. 15, 1963).

The study of a two-level system (TLS) coupled to a loss mechanism (LM), the fluctuations of which are taken into account, is motivated by relating the problem to spin-lattice relaxation, radiation damping, and Brownian motion. A TLS of the electric dipole type (coupled to the LM through one variable only) is discussed first. The problem is formulated in terms of the Pauli spin matrices, and the Langevin equations for Brownian motion of a TLS are derived. Their solution — made possible by taking expectation values in LM space — contains the Weisskopf-Wigner exponential decay formula of radiation theory, as well as a second-order shift in frequency of the TLS produced by the (nondispersive) LM. A driving force is added to the problem and expressions are obtained for a driven lossy TLS of the electric dipole type. The same analysis is applied to a TLS of the magnetic dipole type and differential equations for the spin matrices, for which the expectation values in LM space have been taken, are obtained. Taking expectation values in TLS space converts these equations into the Bloch equations. Unlike the electric dipole case, no frequency shift is present. (auth)

REACTOR TECHNOLOGY

General and Miscellaneous

Refer also to abstracts 35929 and 36354.

36859 (AFSWC-TDR-62-54) FISSION PRODUCTS FIELD RELEASE TEST III. (General Dynamics/Fort Worth. Div. of General Dynamics Corp., Fort Worth, Tex.). Dec. 1962. Contract AF29(601)-4581. 61p. (AD-295668; FZK-153)

Field experiments were conducted to determine the types and quantities of radioactivity that might be released during the meltdown of a PLUTO-type reactor. Four fission-product releases from the melting of segments of freshly irradiated UO_2–BeO ceramic unclad fuel elements were made at the National Reactor Testing Station in Idaho during the summer of 1961. The fuel samples were melted in high-temperature induction furnaces; three releases were made into collectors designed to trap 100% of the released fission products (with the exception of the noble gases) and one release was made to the atmosphere. Experimental results such as release percent, particle-size distribution, air and ground concentration, deposition velocity, and solubility are given. The quality and value of these data are diminished because of unanticipated difficulties in dissolving the post-melt irradiated fuel pins and mishaps connected with two of the closed release experiments. However, since only sparse data relating to release of fission products from PLUTO fuel elements are available, the experimental results are presented to provide rough indications of fission product release behavior under conditions simulating after-heat melting of the PLUTO core. (auth)

36860 (ANL-6648) CHEMICAL ENGINEERING DIVISION SUMMARY REPORT, OCTOBER–DECEMBER 1962. (Argonne National Lab., Ill.). May 1963. Contract W-31-109-eng-38. 241p.

Summaries are presented of research developments in: chemical–metallurgical processing studies in pyrometallurgy, fuel-processing facilities for EBR-II, and the chemistry of liquid metals; fuel-cycle applications of volatility fluidization techniques to laboratory- and engineering-scale investigations of fluoride volatility processes, and the conversion of UF_6 to UO_2; calorimetry studies of the combustion of metals in fluorine, and the development of a high-temperature enthalpy calorimeter; reactor safety evaluations of metal oxidation and ignition kinetics, and metal–water reactions; energy-conversion studies of regenerative emf cells, and thermoelectricity; the determination of nuclear constants for double neutron capture experiments, and capture and fission reactions in EBR-II; and routine operations in waste processing and in the high-level gamma-irradiation facility. (B.O.G.)

36861 (ANL-6764) REACTOR DEVELOPMENT PROGRAM PROGRESS REPORT, JULY 1963. (Argonne National Lab., Ill.). Aug. 15, 1963. Contract W-31-109-eng-38. 74p.

Development progress is reported on fast reactors, liquid metal cooled reactors, ZPR-III, ZPR-VI, ZPR-VII, Faret, EBR-I, EBR-II, Borax-V, Treat, Fermi Fast Breeder Reactor, magnetohydrodynamic cells, thermionic cells, rocket fuel test reactor, and HiC critical assembly. Reactor technology is reported on fuel development and properties, heat engineering, physics, materials development, chemical separations, nuclear safety, and nondestructive testing. (N.W.R.)

36862 (CEND-131) CRITICAL EXPERIMENTS WITH LOW ENRICHED DOUBLE ANNULAR SUPERHEAT ELEMENTS IN LIGHT WATER AND THEIR ANALYSIS. P. G. Klann, C. O. Dechand, and E. Fein (Combustion Engineering, Inc. Nuclear Div., Windsor, Conn.). Dec. 1961. Contract AT(11-1)-795. 49p.

Experiments were carried out on a series of light-water-moderated hexagonal configurations of double annular elements on a triangular lattice. Measurements were made on the core criticality in terms of partial water height and rod bank position, power distributions, lattice parameters, and reactivity coefficient. The experiments included double annular elements encased in poison sleeves, flooding of outer zones, etc. The analytical design method for simple rods was used for the complex double annular elements, and the calculated results are compared with the experimental results. The agreement was good for the eigenvalue and power distributions, although large discrepancies (<13%) occurred in the power distributions in cores containing large explicit slab and Y water channels. (D.L.C.)

36863 (CRCE-1096) FOULING IN ORGANIC-COOLED SYSTEMS. D. H. Charlesworth (Atomic Energy of Canada Ltd., Chalk River, Ont.). Apr. 1963. 86p. (AECL-1761)

Studies of organic coolants in the out-reactor 250-0-1 loop and in the in-reactor X-7 loop showed that fouling films are deposited on heat-transfer surfaces by two mechanisms, one involving soluble impurities and the other insoluble impurities in the coolant. The simultaneous action of two mechanisms of deposition can lead to a wide variety of compositions and structures of the deposited film. The concentration of impurities is the most important factor controlling the deposition rate. Coolant velocity and surface temperature also have major effects on the fouling rate. At low chlorine levels continuous coolant cleanup through Attapulgus clay was shown to reduce deposition rates under representative reactor conditions from 100 to 1 $\mu g/cm^2$ hr. Chlorine, which is a strong promoter of fouling, is not removed by Attapulgus clay. An acceptable deposition rate of 0.3 $\mu g/cm^2$ hr should be achieved by intensive purification, coupled with the exclusion of impurities such as chlorine. (auth)

36864 (CRRP-1151) A G-20 PROGRAM FOR STUDYING XENON SPATIAL OSCILLATIONS AND APPLICATION TO CANDU. R. M. Pearce and R. E. Roth (Atomic Energy of Canada Ltd., Chalk River, Ont.). July 1963. 53p. (AECL-1803)

The G-20 program XENOSC simulates xenon spatial oscillation in two dimensions by solving the two velocity group diffusion equations with xenon-dependent coefficients. Finite time steps are used in calculating the iodine and xenon concentrations at every space point. High accuracy can be obtained with XENOSC because the thermal flux need not be assumed constant during the finite time step but can be extrapolated as a quadratic in time. XENOSC confirms previous predictions that the first azimuthal mode of CANDU is stable. (auth)

36865 (EUR-304.e) STUDY OF A NUCLEAR POWERED TANKER–RADIATION DOSES FROM A WATER RE-

ACTOR LOOP. A. Gallo Curcio (Italy. Comitato Nazionale per l'Energie Nucleare, Rome); A. M. Moncassoli (FIAT. Sezione Energia Nucleare, Turn); and S. Todisco (Societa Ricerche Impianti Nucleari, Milan). 1963. 18p.

The experimental measurements and theoretical analysis of the gamma dose rate from the primary loop of the Avogadro RS-I Reactor are described. The comparison of experimental with calculated dose rates, particularly on the pump hall walls, gives an agreement within 10%. A disagreement by a factor of 2 is found between calculated and measured absolute source values. This investigation enables one to conclude that in performing isodose calculations it is only necessary to evaluate the contribution from the main sources, disregarding back scattering and shadow effects. (auth)

36866 (GAMD-2873) EXPERIMENTS AND ANALYSIS ON BERYLLIUM OXIDE MODERATED CORES CONTAINING HYDROGEN. W. B. Wright and R. G. Bardes (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Jan. 22, 1962. Contract AT(04-3)-187. 31p.

The reactivities of a number of cores containing BeO and polyethylene, which simulated water flooding, were measured and calculated. Other determinations included core symmetrics, reactivity worths of rods and rod voids, and perturbations on assembly reactivities. The experimental arrangements and measurements, the calculational methods used in the analysis, and the results of the analytical-experimental comparison are described. (D.C.W.)

36867 (GEAP-4229) IN-CORE INSTRUMENTATION DEVELOPMENT PROGRAM. TELEMETERING TRANSMITTALS FOR IN-CORE POWER MONITORING. Quarterly Progress Report, January–March 1963. A. H. McQueen (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.). [Apr. 1963]. Contract AT(04-3)-189. 34p.

Development work was conducted for the development of high-temperature, nuclear radiation-resistant, telemetering devices. The development program is devoted to: (1) investigation and selection of two possible telemetering devices, an electromechanical commutating switch and an AM oscillator employing TIMM circuit elements, (2) procuring the electromechanical commutating switch to specification, (3) building and operating a TIMM oscillator, and (4) temperature testing of both devices. The electromechanical commutating switch has been purchased to specification; however, the device has not been received. Circuit development and operation of a TIMM oscillator is continuing with construction, operation, and temperature testing of the oscillator being conducted. (auth)

36868 (GEMP-78) REACTOR INSTRUMENTATION AND CONTROL PROGRESS REPORT NO. 78. (General Electric Co. Advanced Technology Services, Cincinnati). July 31, 1963. Contract AT(40-1)-2847. 41p.

A summary is given of developments such as: design of an electromagnetic shim-scram actuator for reactors; design of a bistable fluid amplifier for driving circulating-ball reactor-control devices; development of transistorized temperature controllers using controlled rectifiers, a three-channel trip circuit, and a two-out-of-three logic circuit using controlled switches; testing of dielectric temperature sensors; and development of nuclear sensors (T.F.H.)

36869 (GNEC-287) DEVELOPMENT OF HYDRAULIC BALL (HY-BALL) CONTROL SYSTEM. Quarterly Progress Report No. 4, April–June 1963. (General Nuclear Engineering Corp., Dunedin, Fla.). June 29, 1963. Work Performed under United States–Euratom Joint Research and Development Program. Contract AT(38-1)-207. 78p. (EURAEC-800)

Physics analyses of axial power distributions for the Hy-Ball controlled core continued. Axial power distributions were computed for a two-zone fuel-enrichment scheme; the computations included all effects with the exception of changes due to fuel burnup. A brief preliminary study comparing the control effectiveness of spherical and cylindrical control elements was completed. A study and tests on a gravity-scram type of system, which is considered as an alternate to the preliminary reference design reversed-flow scram type of system, were begun. Tests, using the cold-test loop which operates with water at room temperature, were conducted with the following configurations: eductor-driven system, gravity-scram system, single-stage plug-buffer, plug-valve buffer, inverted plug-valve buffer, and five-column parallel-stepped system. The design, construction, and checkout tests of the hot-test loop were completed on schedule. The first test, with Hy-Ball assemblies operating in 545°F, 1000 psia water for 500 hours, was completed. During this test a downward flow of water was maintained in the Hy-Ball columns; this condition simulated the reactor condition of holding the control elements in the in-core position for a reasonably long period of time. (auth)

36870 (APDA-154) FAST REACTOR FUEL CYCLE COSTS AND TEMPERATURE COEFFICIENTS OF REACTIVITY FOR PuO_2–SS AND PuO_2–UO_2. J. J. Edwards, E. A. Fischer, W. H. Jens, J. B. Nims, R. G. Palmer, A. A. Shoudy, and R. C. Williams (Atomic Power Development Associates, Inc., Detroit). Apr. 25, 1963. Contract AT(11-1)-865. 66p.

The fuel cycle costs and temperature coefficients of reactivity for PuO_2-stainless steel cermet fuel and PuO_2–UO_2 fuel in 100, 300, and 500 Mw(e) fast reactors were calculated for comparison. The fuel cycle costs for the cermet are found to decrease with increasing reactor size from 3 to 2 mills/kw/hr. The mixed oxide fuel shows a 1 mill/kw/hr advantage in all reactor sizes for the assumptions of 1975 costs and burnup used. The cost advantage is small compared to the inaccuracies in the assumptions used for the study. The cermet fuel has a positive Doppler coefficient of reactivity which is small in comparison to the coefficient of reactivity associated with the fuel matrix expansion and, therefore, is not considered to be a problem. The sodium coefficient of reactivity is negative for both large and small cermet cores. The Doppler coefficient for the small oxide cores is negative and small and insufficient to overcome any undesirable reactivity effects due to longitudinal fuel movement if these should occur. The sodium coefficient of reactivity in the large oxide core is positive. (auth)

36871 (KR-47) K-7 THERMOS (NEUTRON THERMALIZATION IN A HETEROGENEOUS CYLINDRICALLY SYMMETRIC REACTOR CELL). R. J. J. Stamm'ler (Norway. Institutt for Atomenergi, Kjeller and Netherlands. Reactor Centrum, The Hague). June 1963. 94p.

The basic physical theories and the programming of the multigroup and multiregion K-7 THERMOS program, which solves the space and energy dependent integral transport equation in an infinitely long heterogeneous reactor cell with cylindrical symmetry and a reflecting boundary, are given. The thermal neutron distribution in space and energy so obtained can be used as input for a supplementary code (given) that calculates thermal utilization, reaction rates, etc. The mathematical formulation and ALGOL translation of the code are included. (D.C.W.)

36872 (LADC-5773) THE MINOTAUR I REMOTE MAINTENANCE MACHINE. R. W. Wiesener (Los Alamos Scientific Lab., N. Mex.). [1962]. Contract [W-7405-eng-36]. 13p. (CONF-187-8)

For Presentation at American Nuclear Society Meeting, New York, Nov. 1963.

A remotely operable, electromechanical maintenance machine (named MINOTAUR I) was designed and built by General Mills Incorporated, to Los Alamos Scientific Laboratory specifications and design criteria. The machine includes two electromechanical manipulators, closed circuit TV cameras, 500-pound hoist, lights, and an audio system, which are mounted on a spherical casting. MINOTAUR I is mounted on a telescoping tube assembly, which is suspended from an overhead bridge crane. (auth)

36873 (LADC-5783) STRUCTURAL MATERIALS IN LASL LIQUID SODIUM SYSTEMS. Howard I. Bowers and William E. Ferguson (Los Alamos Scientific Lab., N. Mex.). [1963]. Contract [W-7405-eng-36]. 59p. (CONF-187-5)

For Presentation at American Nuclear Society Meeting, New York, Nov. 1963.

A discussion is presented of the design, fabrication, and post-operative tests and inspections of the 2000 kw Sodium Test Facility which was constructed and operated at the Los Alamos Scientific Laboratory. Of special interest are (1) post-operative inspection of heat exchanger tubing, (2) the investigation of a rupture in a thermocouple well, and (3) the investigation of the thermal stress fatigue cracking of a pipe tee and adjacent piping. Discussed briefly are (1) operating experience with 17-4 PH stainless steel in the LAMPRE sodium system and (2) the results of corrosion tests of tantalum in cold-trapped and hot-trapped sodium. (auth)

36874 (LADC-5789) DESIGN STUDY OF FUEL CONVEYOR SYSTEMS FOR ULTRA HIGH TEMPERATURE REACTOR EXPERIMENT. F. M. Black and P. R. Franke, Jr. (Los Alamos Scientific Lab., N. Mex.). [nd]. Contract [W-7405-eng-36]. 14p. (CONF-187-2)

For Presentation at American Nuclear Society Meeting, New York, Nov. 1963.

A description is given of a design study for conveyor systems to be used for transporting fuel elements to and from the Ultra High Temperature Reactor Experiment (UHTREX). The fuel element is a graphite-uranium cylinder 1 inch in diameter by 5 inches long with a $\frac{1}{2}$-inch center hole extending its full length. Governing system design parameters include high reliability, capability of remote replacement and maintenance, maximal protection of personnel from radiation (about 10^8 neutrons/cm^2-second with attendant gamma), appropriate radiation-resistant equipment, and positive positioning of carriers at the loading and unloading terminals. Additionally, it was necessary to adapt the conveyor system to a building under construction and to the concept of fuel replacement during full operation of the reactor. (auth)

36875 (ORNL-TM-611) INHERENT NEUTRON SOURCES IN CLEAN MSRE FUEL SALT. P. N. Haubenreich (Oak Ridge National Lab., Tenn.). Aug. 27, 1963. Contract [W-7405-eng-26]. 17p.

Unirradiated MSRE fuel salt will contain an appreciable neutron source due to spontaneous fission of the uranium, and (α,n) reactions of alpha particles from the uranium with the fluorine and beryllium of the salt. The spontaneous fission source in the core (25 ft^3 of salt) is 10^3 neutrons/sec or less, mostly from U^{238}. The alpha-n source is much larger, giving about 4×10^5 neutrons/sec in the core. Nearly all of this latter source is caused by alpha particles from U^{234}. (auth)

36876 (ORNL-TM-678) PARTIALLY ENRICHED FUEL CYCLES. Floyd L. Culler, Jr. (Oak Ridge National Lab., Tenn.). Sept. 3, 1963. Contract W-7405-eng-26. 45p. (CONF-178-1)

From European Atomic Energy Society's Symposium on Fuel Cycles for Power Reactors, Baden-Baden, Germany, Sept. 1963.

The lowest fuel cycle costs for converter reactors can be achieved by use of natural uranium fuels in heavy water-moderated reactors of very large size. Natural uranium fuel cycles operated at cycle capacities of 10 t/d and larger offer overall fuel costs that are small, about 0.05 mill/kwhr thermal, or 0.18 mill/kwhr electricity at 28% thermal efficiency. These costs assume 14%/yr charge on capital, a 5.5% charge on consumable inventories, burnup of 7000 Mwd/ton of uranium and a plutonium credit of $6.70/g. If plutonium is not recovered but discarded, the costs are approximately 0.9 mills/kwhr electricity. Plutonium can be recovered and recycled with depleted uranium to the same reactor system for approximately 20% increase in fuel cycle costs over the natural uranium case. This natural uranium cycle is probably a factor of five less costly than the least expensive partially enriched uranium case if plutonium (where initial U^{235} is 1.5 wt % or higher) is recovered and sold; a factor of two less than the least expensive enriched case if plutonium is not recovered, particularly in fuel cycles of less than several tons per day capacity; and its attractive economically if the plutonium produced is recycled with depleted uranium. (auth)

36877 (TID-8200(8th Rev.)) NUCLEAR REACTORS BUILT, BEING BUILT, OR PLANNED IN THE UNITED STATES AS OF JUNE 30, 1963. (Division of Reactor Development, AEC). 28p.

Tables are presented which give information on the reactor facilities built, being built, and planned in the U. S. The tables are arranged according to civilian reactors, military reactors, production reactors, reactors for export, and critical assembly facilities. (D.L.C.)

36878 (TID-17548) THE USE OF FILTERS IN NUCLEAR REACTOR CONTAINMENT. John W. Walker and Albert H. Peters (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). [Dec. 1962]. Contract AT(07-2)-1. 23p.

A filtration system was developed for filtering moisture and radioactive materials from ventilation exhaust steam. The system consists of high-efficiency moisture de-entrainment devices "Demisters" (commercial), particulate filters with water-repellent medium (commercial), and activated carbon filters (designed). Results of efficiency tests made under various conditions for all three filter components are given, and the design of the carbon filters is described. (D.L.C.)

36879 (TRG-Report-474) TEMPERATURE DISTRIBUTIONS IN FUEL ELEMENTS. L. R. T. Gardner (United Kingdom Atomic Energy Authority. Reactor Group, Springfields, Lancs, England). Aug. 1962. 40p.

The theory of one dimensional heat flow in fuel elements is extended so that a more general class of problems allowing for heat transfer in the fuel may be studied. The method employs a model resembling electric circuits connected in parallel. Temperature distributions for Notional and Pippa fuel elements obtained by this method are com-

pared with two dimensional analogue and digital computer solutions and with observations of "in-pile" temperatures and found satisfactory. The effect of variation in the design of Pippa and Bradwell fuel elements upon end cap temperatures is investigated and the effect of thin oxide bands of various widths upon maximum uranium surface temperature is discussed. (auth)

36880 (UCRL-7441) AUTOMATIC DATA COLLECTING SYSTEM FOR THE TORY II-C COLD CRITICAL EXPERIMENT. Harlan Aslin (California. Univ., Livermore. Lawrence Radiation Lab.). July 15, 1963. Contract W-7405-eng-48. 17p.

The design of an automatic data collecting system for the Tory II-C reactor critical experiment is an attempt to facilitate the compilation of the large quantity of data necessary for accurate power density measurements. Neutron sensors or probes in the core drive scalers which are controlled by the data system. The scalers are all started simultaneously and count either for a preset time, or count until a preset count is reached, and are then gated off by the system. The system then automatically records, in punched card form, the data associated with each sensor or channel. At the end of the experiment, when all data have been compiled, the cards are run through a computer program. The computer printouts are power density maps of the core. (auth)

36881 THE DYNAMICS OF SOLUTION REACTORS AT HIGH POWER EXCURSIONS. D. Emendoerfer and Ch. Hinze (Technische Hochschule, Stuttgart). Ann. Physik (7), 11: 164-74(1963). (In German)

Power excursions were calculated in solution reactors (kinetic experiments on boiling reactors) with reactor periods of 10^{-2} sec. Temperature increase and void formation in the fission zone lead in 10^{-1} sec to the checking of the chain reaction. The growth of voids, starting with elementary bubbles with 10^{-5}-cm radius, by the diffusion of dissolved radiolytic gases into the bubbles was described. The experimentally determined relation between void variations and pressure was understandable from the bubble growth. (tr-auth)

36882 THE USE OF NUCLEAR REACTORS FOR SEA-WATER DISTILLATION. L. Biondi and A. Vaudo (Servizio Nucleare della Societa Montecatini, Milan). Atompraxis, 9: 328-32(Aug. 1963). (In English)

The possibility of using nuclear energy for distilling sea water is discussed. The first question considered is whether fresh water could be produced on an industrial scale, and if so, under which conditions. After an analysis of the various production-cost factors involved, the possible advantages of sea-water distillation by means of nuclear energy in comparison with conventional methods was examined. (auth)

36883 SAFETY IN THE OPERATION OF ATOMIC REACTORS. J. Furet. Bull. Soc. Franc. Electriciens, No. 36, 638-52(Dec. 1962). (In French)

The severest risk of failure is in starting up and cooling. For the first, the development of neutron output when a failure occurs was analyzed. Methods for ensuring the safe operation of atomic reactors and the requirements to be met by safety systems are discussed. The improvements brought about by automation and the work that still remains to be done in the field of detectors for nuclear and thermodynamic measurements are described. (auth)

36884 TECHNIQUES EMPLOYED IN SAFETY DEVICES FOR NUCLEAR REACTORS. J. Tissot. Bull. Soc. Franc. Electriciens, No. 36, 653-62(Dec. 1962). (In French)

A study was made of the different methods used to reduce rapidly the output of a reactor: introduction of solid rods into the core or the addition of liquid poisons to the liquid moderators, increase of neutron leakage by displacement of the reflector, and release of compressed gas or absorbing liquid by fuses which are sensitive to excessive heat or an increase in neutron flux. Thanks to a high degree of automation of these methods, a judicious choice of material, multiplication of measuring points, and the rational organization of signals emitted by the safety systems, the danger is reduced to a calculable and acceptable risk. (auth)

36885 COLLISION PROBABILITIES IN SUPERLATTICES. H. Kiesewetter (VEB EPkA, Berlin). Kernenergie, 6: 342-5(July 1963). (In German)

An infinitely expanding lattice of cylindrical rods is called a "superlattice" when the lattice squares are regular and are filled with rods that are distinguished from each other by their quality or their position. Superlattices originate, for example, from a regular rod lattice in which, in the regularly distributed lattice square, selected rods of the basic lattice are replaced by positioned or absorbing rods or by moderator (vacancies). For calculation of the spatial propagation of neutrons in a superlattice, the collision probabilities (for the first collision) of each rod type with respect to each other rod type and the moderator and of the moderator with respect to each rod type were used. These collision probabilities were approximately calculated for constant and nonconstant isotropic source distributions assumed in space on the basis of the transport theory. The approximation is that after each passage through a rod surface from the inside and from the outside the effective existing neutron distributions are replaced, using the isotropization method, by isotropic neutron distributions constant along the rod boundary. (tr-auth)

36886 INVESTIGATIONS ON THE URANIUM–PLUTONIUM CYCLE WITH SPECIAL CONSIDERATION OF H_2O MODERATED REACTORS. PART 3. P. Wenzel (VEB EPkA, Berlin). Kernenergie, 6: 346-53(July 1963). (In German)

The effect of a partial plutonium conversion on the equilibrium concentration was theoretically investigated. The increase of the multiplication factor in partial Pu conversion with respect to the value for the total conversion was calculated as a function of the separation coefficient. The optimum conditions for the operation of a light-water-moderated reactor with natural uranium and partially converted plutonium were determined. (J.S.R.)

36887 THE THEORY OF THE INTERACTION CORRECTION OF THE RESONANCE INTEGRAL IN A FUEL-MODERATOR LATTICE. PART I. NRIA APPROXIMATION. A. Mueller (VEB EPkA, Berlin). Kernenergie, 6: 353-62(July 1963). (In German)

The effect of the interaction of the fuel block on the so-called surface term of the resonance integrals in a fuel-moderator lattice was studied within the framework of the NRIA (narrow resonance infinitely heavy absorber) approximation. After a discussion of new and different analytical approximation terms for collision probabilities in regular lattices, the interaction factors of the resonance absorption corresponding to the approximations were calculated. The plate lattice was exactly calculated and referred to the numerical comparison. Sufficiently accurate and relatively simple approximation formulas for the interaction factor of the surface term of resonance integrals were given for all regular lattices of practical significance when the accurate transmission probabilities for isotropic neutrons in

the moderator (Dancoff correction) were used. With consideration of new studies on the calculation of collision probabilities in regular lattices of cylindrical fuel rods, a critical evaluation was made of the numerical interaction factors given by Orlov for this lattice type and of the assertion by Takahashi on the variation in the resonance absorption in plane and cylindrical cells. (tr-auth)

36888 DEVICE FOR MONITORING THE DROP OF REACTOR TRIM RODS. (to Siemens and Halske AG). German Patent 1,119,426. Dec. 14, 1961. Filed May 11, 1959. Kernenergie, 6: 366(July 1963). (In German)

A method for the remote monitoring of whether a control rod is held by the magnets or not is described. The previous holding devices of this sort are not reliable. In the present device the holding coil of the magnet has a center tap and forms two adjacent branches of an a-c bridge. A-c voltage feeds the diagonals surrounding the center tap and in the other diagonal a relay is closed that reports the drop of the rod. With this circuit a possible modification of the magnet traction by the measurement current can be avoided. The measurement current can be chosen so high that the bridge can directly operate a relay. (J.S.R.)

36889 CONTROL AND SHUT-DOWN ELEMENTS FOR REACTORS. (to Siemens-Schuckertwerke AG). German Patent 1,099,101. Feb. 9, 1961. Filed Mar. 21, 1959. Kernenergie, 6: 366(July 1963). (In German)

With the insertion of control rods into the fission zone of a reactor, a sharp flux distribution, and therefore an unfavorable fuel burn-up, can occur. In order to avoid this, the new control and shutdown elements were built so that the sheath (absorbing layer) consists of an absorber fluid that rests on it in the element housing and is replaceable with a moderator or fuel body placed in the housing with tolerance in the space between the body surface and element housing. In the simplest case, the removable body is formed of elongated rods and the element housing is a sealed cylinder. An electromagnetic drive with position recording is used as rod drive. (J.S.R.)

36890 HEAT INSULATORS BUILT UP FROM LAYERS FOR THE MODERATOR VESSEL OF A REACTOR. (to Siemens-Schuckertwerke AG). German Patent 1,108,340. June 8, 1961. Filed May 14, 1958. Kernenergie, 6: 366 (July 1963). (In German)

A heat resistor built from layers is described for the moderator vessel and the constituents of the liquid-moderated reactor led through it. The layers consist of foils between which the moderator is filled so that the layers have distances from each other of such size that no heat transfer by convection to the moderator in the interstices is possible. (J.S.R.)

36891 METHOD AND DEVICE FOR THE WITHDRAWAL OF RADIOACTIVE EXHAUST GASES AND A DECAY VESSEL. (to Siemens-Schuckertwerke AG). German Patent 1,116,835. Nov. 9, 1961. Filed Dec. 17, 1960. Kernenergie, 6: 366(July 1963). (In German)

In nuclear installations gases that cannot be released because of their radioactivity are stored until the activity decays to a tolerable level. The gases were released from pressurized decay vessels in small masses by pressure and volume controls and were led to a flue mixed with air as a carrier or a diluent. If the decay vessel is constructed within the reactor structure, a leak can cause rapid poisoning of the area. A proposal was made to replace the gas withdrawn from the decay vessels at atmospheric pressure with an equal mass of air. For this purpose a chamber with a back and forward motion is proposed. This chamber takes up in its rear section the gas from an exhaust circuit sealed in the decay vessel. At the other end this gas is released to a scavenger air circuit and replaced with scavenging air. Since the decay vessel is under atmospheric pressure or low pressure, rapid escape of the effluent gases is prevented if the vessel should leak. (J.S.R.)

36892 CONTROL ELEMENTS FOR REACTORS. (to Siemens-Schuckertwerke AG). German Patent 1,118,901. Dec. 7, 1961. Filed Mar. 21, 1959. Kernenergie, 6: 366 (July 1963). (In German)

The production of a reactor control rod with no movable parts is described. The system is built as an electrolytic system consisting of two electrodes insulated from each other with the space between the electrodes filled with electrolyte solution. It contains a neutron-absorbing material of which differing fractions are found on the electrodes and in the solution according to the operating conditions of the control elements. (M.C.G.)

36893 REACTOR OPERATOR QUALIFICATIONS. Ernest E. Hill and Frederick J. Shon (Univ. of California, Livermore). Nucl. News, 6: No. 9, 19-25(Sept. 1963).

The type of person considered most suited to operate a reactor is described, noting desirable mental, physical, and personality requirements. Topics covered include: education, experience, personality, class-room training, on-the-job training, continuation of training, qualifying examinations, and performance evaluation. (Types of questions asked are included). (M.C.G.)

36894 SEMIANALYTICAL AND SEMINUMERICAL CALCULATIONS OF OPTIMUM MATERIAL DISTRIBUTIONS. C. I. Gunnar Andersson (AB Atomenergi, Stockholm). Nukleonik, 5: 185-91(Aug. 1963). (In English)

Perturbation theory applied to the multigroup diffusion equations gives a general condition for optimum distribution of reactor materials. A certain function of the material densities and the fluxes, here called the W(eight)-function must thus be constant, where the variable material density is larger than zero, if changes in this density affect only the group constants where the changes occur. The weight function is, however, generally a complicated function and complete solutions were therefore previously presented only for the special case when constant weight function implies constant thermal flux. It is demonstrated here, that the condition of constant weight function can be used together with methods for numerical solution of the multigroup diffusion equations to obtain optimum material distributions also when the thermal flux varies over the core. Solution of the minimum fuel mass problem for two reflected reactors thus shows, that an effective reflector such as D_2O gives a peak in the optimum fuel distribution at the core-reflector interface, while an ineffective reflector such as a breeder blanket or a steel tank wall "pushes" the fuel away from the strongly absorbing zone. (auth)

36895 PROMPT SUPERCRITICAL POWER EXCURSIONS IN FAST REACTORS. Wolf Haefele (Kernforschungszentrums, Karlsruhe, Ger.). Nukleonik, 5: 201-8 (Aug. 1963). (In German)

The critical behavior of a reactor with a sloping form for inserted reactivity and with reaction of a prompt negative temperature coefficient was investigated. The peculiarities of fast reactors and their differences from thermal reactors were determined. The condition was studied in which the size of the prompt negative temperature coefficient can be determined from the course of the (prompt) supercritical power excursion. This method for

the determination of the prompt (Doppler) temperature coefficient is of interest for fast reactors and allows the use of high temperatures in fuel materials and represents a valuable supplement to measurement methods in critical zero-energy arrangements. (M.C.G.)

36896 CALCULATION OF THERMAL NEUTRON SPECTRA IN HETEROGENEOUS REACTORS. W. Oldekop (Siemens-Schuckertwerke AG, Erlangen, Ger.). Nukleonik, 5: 214-22(Aug. 1963). (In German)

A knowledge of the thermal neutron spectrum inside a lattice cell is important for the calculation of the overall thermal cross sections, and thus of η and f. Three different methods for calculating the spectrum are described. The first of them generalizes the Wilkins' theory to include the case of heterogeneous media. The spatial dependence of the spectrum is taken into account with the help of collision probabilities. The second method is a multigroup P_1 approximation. The third is a multigroup-multizone approximation. In the last-mentioned method, the multigroup procedure of the P_1 approximation is combined with the multizone procedure of the generalized Wilkins' theory. With the help of a few examples, the three methods are compared both with each other and with other methods. Certain other examples are used to demonstrate the effect of the moderator temperature, the coolant temperature, and the fuel temperature on the neutron spectrum in a typical power reactor. (auth)

36897 SHOCK WAVE ANALYSIS OF THE CONSEQUENCES OF A REACTOR ACCIDENT. Alton E. Klickman, Richard B. Nicholson, and John B. Nims (Atomic Power Development Associates, Inc., Detroit). 14p. (CONF-39-22)

From American Nuclear Society Meeting, Salt Lake City, June 1963.

The solution to the problem of transmission and attenuation of the shock wave resulting from a large reactor accident is demonstrated for a configuration typical of many reactors. The particular configuration is that of a spherical gas bubble surrounded by one or more concentric regions of compressible material. A systematic parameter study was made in which the physical characteristics of the compressible shield regions and the expansion characteristics of a gas were assumed to be parameters. Results for seven cases are shown, and similar cases with only one important difference are compared. From these comparisons it was concluded that under certain conditions alternative materials can be substituted for reactor materials in model experiments and TNT can be used as an energy source instead of uranium. In the outer crushable region the total mass of material is the important factor. (A.G.W.)

36898 EXPERIMENTS AND ANALYSIS OF WATER REFLECTED, UNDERMODERATED ZIRCONIUM HYDRIDE CRITICAL ASSEMBLIES. PART II. ANALYSIS. B. W. Colston (Atomics International, Canoga Park, Calif.). 4p. (CONF-39-32)

From American Nuclear Society Meeting, Salt Lake City, June 1963.

Previously described experiments were analyzed using existing nuclear codes and cross section libraries. One- and two-dimensional calculations were done. The results indicated about a 1.5% difference in reactivity between the two techniques. Detailed results are not included. (A.G.W.)

36899 CANADIAN EXPERIENCE WITH REACTOR MODERATOR AND COOLANTS. R. F. S. Robertson and H. K. Rae (Atomic Energy of Canada Ltd., Chalk River, Ont.). 24p. (CONF-9-19)

From Canadian Nuclear Association, International Conference and Future Development of Power Reactors and on Radioisotopes, Montreal, May 1963.

The various substances that are envisaged for use as moderator as a primary coolant in the Canadian reactor program are discussed. Topics covered include: pressurized water as coolant, boiling-water and fog coolants, steam as coolant, organic liquids as coolant, and heavy water as moderator. (M.C.G.)

36900 IMPROVEMENTS IN OR RELATING TO CONTROL RODS FOR NUCLEAR REACTORS. (to General Dynamics Corp.). British Patent 931,974. July 24, 1963. Priority date Mar. 24, 1961, United States.

A reactor control rod composed of a plurality of sections of different concentrations of burnable poison is patented. The sections may be nested shells within an outer can, each section having a predetermined concentration of a burnable neutron-absorbing poison such as compounds of Gd, Cd, or Sm. The sections are arranged so that the poison compensates for the loss of excess reactivity in the reactor core and also for variations in neutron flux at different levels in the reactor core. The sections of shells may be the entire length of the control rod, or they may be only a few inches in length, so that the rod would consist of a plurality of stacked sections. (M.P.G.)

36901 IMPROVEMENTS IN OR RELATING TO NUCLEAR REACTORS. (to General Dynamics Corp.). British Patent 931,997. July 24, 1963. Priority date Dec. 7, 1960, United States.

An arrangement of fuel elements in a reactor having a pressure vessel, a core within the vessel, and a top grid plate for the core is patented. The arrangement is particularly applicable to high-power gas-cooled reactors with graphite-encased fuel elements. A plurality of fuel elements arranged to form a cluster are hung by the top from a structure mounted on the grid plate. The elements are spaced to allow coolant to flow across their tops, and the cluster can be moved as a unit by a fuel handling mechanism. The fuel elements and the hangers have passages to allow the purge flow of fission products to flow into fission-product traps. (M.P.G.)

36902 IMPROVEMENTS RELATING TO NUCLEAR REACTORS. Thomas Cyril Greaves (to English Electric Co., Ltd.). British Patent 932,171. July 24, 1963. Filed Feb. 10, 1959.

The design of a control-rod cable-winding mechanism is patented. The mechanism consists of a fixed multiple-pulley block, a movable multiple-pully block, and a rope or cable passing around all the pulleys of both blocks and having one end connected to a control rod. The cable passes through a tortuous passage in a concrete shield between the winding mechanism and the control rod. The movable block is moved by a hydraulic, pneumatic, electrical, or mechanical actuator to vary the distance between the two blocks. Movement of the movable block produces a magnified movement of the control rod. (M.P.G.)

36903 IMPROVEMENTS IN CONTROL ROD DRIVE MECHANISMS FOR NUCLEAR REACTORS. (to General Dynamics Corp.). British Patent 932,249. July 24, 1963. Priority date July 28, 1959, United States.

A remotely operated reversible drive mechanism for positioning reactor control rods is patented. An element, which is movable in a controlled vertical path, is connected to a control rod. A reversible, two-phase electric motor moves the element to the desired position. The relationship of the phases of the currents in the windings of the motor can be temporarily adjusted to cause the

motor to rotate in either direction until the element is in the desired position. A biasing means is provided to adjust the phases of the currents so that a minor amount of motor torque is maintained to neutralize the force applied to the motor by the action of gravity on the element and control rod. (M.P.G.)

36904 IMPROVEMENTS RELATING TO FUEL ELEMENTS FOR NUCLEAR REACTORS. Piyatilleke Perera Gu Neratne and Charles Herbert Quinton Fifield (to United Kingdom Atomic Energy Authority). British Patent 932,264. July 24, 1963. Filed May 24, 1961.

The design of a thermocouple cable for a reactor fuel element is patented. The cable has a section with reduced cross section, allowing the cable to break at this point when it is pulled. The cable may then be withdrawn from the reactor, and the fuel element can be discharged in the normal way without danger of the cable becoming entangled in the machinery. The section of the cable with reduced cross section is protected by a sleeve attached to the cable or to the fuel element. (M.P.G.)

36905 IMPROVEMENTS IN OR RELATING TO DEVICES FOR WITHDRAWING COMPONENTS FROM NUCLEAR REACTORS. Samuel Brittan Hosegood, Bernard William Collins, and Cecil Harper (to United Kingdom Atomic Energy Authority). British Patent 932,438. July 24, 1963. Filed Dec. 12, 1960.

A device particularly adapted to withdrawing fuel-element mounting members from their supporting structure in a reactor is patented. The mounting member is in the form of a conical spike supported at its base in the lower region of a reactor core. The withdrawing device consists of a casing, which can be manipulated by the reactor charge machine, a gripping mechanism carried by the casing, and a mechanism within the casing for exerting a force on the gripping mechanism to detach the mounting member and withdraw it into the casing. Details of the design are described. (M.P.G.)

36906 IMPROVEMENTS IN OR RELATING TO NUCLEAR FUEL ELEMENTS. Peter Waine and James Duncan Waters (to United Kingdom Atomic Energy Authority). British Patent 932,463. July 24, 1963. Filed Oct. 27, 1960.

A supporting structure to restrain bowing in clusters of fuel rods is patented. The cluster consists of a plurality of closely spaced parallel fuel rods in a tubular housing. Bowing is restrained by an openwork structure of thin-walled stainless steel tubular members, which encircle the fuel rods with clearance over an intermediate length of the rods and are interconnected by webs. The supporting-structure members are edge-on to coolant flow through the fuel-rod housing. (M.P.G.)

36907 IMPROVEMENTS IN OR RELATING TO NUCLEAR FUEL ELEMENTS. Peter Waine and James Duncan Waters (to United Kingdom Atomic Energy Authority). British Patent 932,464. July 24, 1963. Filed Oct. 27, 1960.

A supporting structure to reduce vibrations in clusters of fuel rods is patented. The cluster consists of a plurality of closely spaced parallel fuel rods in a tubular housing. The supporting structure of openwork construction is fabricated from strip material with transverse troughs at intervals. The strips are assembled with the troughs coming together to form spaced openings for the ends of the fuel rods. The strip material between the troughs is joined to form webs of double thickness and secured by localized welding remote from the fuel-rod openings. (M.P.G.)

36908 IMPROVEMENTS IN OR RELATING TO FUEL ELEMENTS FOR NUCLEAR REACTORS. James Thomas Stockdale and Alan Frederick Taylor (to United Kingdom Atomic Energy Authority). British Patent 932,623. July 31, 1963. Filed July 18, 1960.

An improvement in the design of sheathed reactor fuel elements is patented. The sheaths are closed to each end by an end cap having a plain skirt, which is a close fit on the end of the sheath, and a circumferential sealing weld is made between the end of the sheath and the end-cap skirt. A circumferential groove containing nuclear fuel is located in the skirt of each end cap to provide early warning of faulty welds by the escape of fission products into the coolant. The patented improvement consists of one or more longitudinal grooves connecting the circumferential groove with the interior of the fuel element sheath. This prevents trapped gas in the circumferential groove from escaping during welding and making blow holes in the molten weld metal. (M.P.G.)

36909 IMPROVEMENTS IN OR RELATING TO REMOTELY CONTROLLED PLANT FOR TRANSFERRING NUCLEAR FUEL ELEMENTS TO A REACTOR. George Edward Lockett, Gianfranco Franco, Alfred Norman Kinkead, and Viggo Henning Srensen (to United Kingdom Atomic Energy Authority). British Patent 932,794. July 31, 1963. Filed June 24, 1960.

A system for remote handling of vertically loaded fuel elements, in which radiation hazards are considerably reduced, is patented. A transfer flask for carrying fuel elements is mounted within the inner containment structure of the reactor. The flask contains a mechanism for lowering and raising the fuel element into and out of the flask. The flask can be moved to a number of ports in the floor of the transfer passage, that communicate with the loading bay, an irradiated fuel-element storage facility, a canning cell, and a reactor-pressure-vessel entry port. (M.P.G.)

36910 HEAT EXCHANGERS FOR NUCLEAR REACTORS. (to Brown, Boverie & Cie AG). British Patent 932,796. July 31, 1963. Priority date Apr. 28, 1959, Germany.

A heat exchanger designed particularly for high-temperature reactors is patented. Tubes carrying the heat-dissipating medium are arranged in horizontal involute patterns and are suspended in the coolant from vertical tubes cooled by superheated steam. Two or more water-deflecting grids are provided at the barriers between the heat exchanger and the core of the reactor to prevent the heat-dissipating medium from entering the core if a tube ruptures. The heat exchanger allows a uniform distribution of the coolant around the tubes of the heat-dissipating medium, thereby increasing the efficiency of heat transmission. (M.P.G.)

36911 METHOD OF AND MEANS FOR RELIEVING PRESSURE IN GAS CONTAINERS. (to Allmanna Svenska Elektriska Aktiebolaget). British Patent 932,878. July 31, 1963. Priority date May 26, 1961, Sweden.

A method of relieving the pressure in a gas container without the risk of leakage or the use of very large collecting vessels is patented. The method is applicable to containers of radioactive fission gas from a reactor. The gas container is connected to several collecting vessels with openable and closable connection conduits. The container is placed in open communication with one collecting vessel at a time, and the collecting vessel is closed after the pressure in the container and the collecting vessel is the same. The container is then placed in open communication with another collecting vessel. The last collecting

vessel is evacuated to a pressure below atmospheric pressure before open communication is made with the gas container. This reduces the pressure in the gas container to below atmospheric pressure and prevents leakage. (M.P.G.)

36912 IMPROVEMENTS IN OR RELATING TO HETEROGENEOUS LIQUID MODERATED NUCLEAR REACTORS. Clifford Graham Campbell, Raymond Kenneth Hilton, and George Robert Jamieson (to United Kingdom Atomic Energy Authority). British Patent 934,612. Aug. 21, 1963. Filed July 10, 1961.

The design of a liquid-moderated reactor, which has a core particularly suited to the replacement or rearrangement of fuel, is patented. The reactor consists of a container for the liquid moderator and a means for locating a plurality of frames in parallel planes within the container. The frames can releasably hold fuel elements and are guided vertically during charging and discharging by extension rods. The frames are locked into position in the container and cannot be removed before the extension rods are inserted. The reactor container has a slotted lid, which slides over the top of the container until a slot coincides with a selected frame. (M.P.G.)

36913 BOILING WATER NUCLEAR REACTOR. (to General Nuclear Engineering Corp.). British Patent 934,656. Aug. 21, 1963. Priority date Oct. 9, 1959, United States.

The design of a boiling water reactor using a combination of natural and forced circulation of coolant is patented. The reactor is supplied with subcooled feedwater, which is proportioned between separate regions of the reactor. The steam is separated from the water at separate locations for each region and conveyed to a point of use. The power output of the reactor is controlled by regulating the flow of water into the reactor as well as by the use of control rods. The separate core regions of the reactor are internested, and a pump is used to force the water up through the central core region. (M.P.G.)

36914 SIMPLIFIED SODIUM GRAPHITE REACTOR SYSTEM. (to North American Aviation, Inc.). British Patent 934,683. Aug. 21, 1963. Priority date Nov. 27, 1959, United States.

The design of an improved Na-graphite reactor system with a simplified primary heat-exchange loop is patented. The reactor consists of a calandria core vessel in conjunction with an overflow-type primary Na system. Radiation shielding around the reactor core within the vessel forms an annular volume between the shielding and the vessel walls. Na is pumped upward through the core into a plenum at the top of the reactor and overflows through the annular volume, which contains the intermediate heat exchanger. All of the primary Na system is confined to the reactor vessel. The reactor tank contains unclad graphite moderator and a number of process tubes containing fuel elements passing longitudinally through the graphite. (M.P.G.)

36915 IMPROVEMENTS RELATING TO HEAVY WATER REACTORS. (to Aktiebolaget Atomenergi). British Patent 935,258. Aug. 28, 1963. Priority date Dec. 7, 1959, Sweden.

A process for changing the core of a heavy-water reactor while maintaining continuous cooling of the fuel elements is patented. After the reactor has been shut down, the heavy water is drawn off and saved in a container, and the fuel elements are cooled by spraying with heavy water. The reactor is then flushed by blowing a gas through the reactor, while spraying the fuel elements with light water. The mixture of heavy and light water obtained is collected and saved in a separate container. The reactor is then filled with light water and opened. The old core is moved out and a new or repaired core is moved in under cover of the light water. The process is then reversed for drawing off the light water and replacing it with heavy water. The process has the advantage of proving a light-water-filled channel for moving cores out and in, since heavy water is expensive and has low shielding properties. A reactor plant for carrying out the process is also patented. (M.P.G.)

36916 HYDRAULIC SERVO CONTROL MECHANISM. R. B. Hussey and M. J. Gottsche, Jr. (to U. S. Atomic Energy Commission). U. S. Patent 3,103,853. Sept. 17, 1963.

A hydraulic servo control mechanism of compact construction and low fluid requirements is described. The mechanism consists of a main hydraulic piston, comprising the drive output, which is connected mechanically for feedback purposes to a servo control piston. A control sleeve having control slots for the system encloses the servo piston, which acts to cover or uncover the slots as a means of controlling the operation of the system. This operation permits only a small amount of fluid to regulate the operation of the mechanism, which, as a result, is compact and relatively light. This mechanism is particularly adaptable to the drive and control of control rods in nuclear reactors. (auth)

36917 FUEL ELEMENT FOR NUCLEAR REACTORS. James J. Dickson (to U. S. Atomic Energy Commission) U. S. Patent 3,105,026. Sept. 24, 1963.

A method is described whereby fuel tubes or pins are cut, loaded with fuel pellets and a heat transfer medium, sealed at each end with slotted fittings, and assembled into a rectangular tube bundle to form a fuel element. The tubes comprising the fuel element are laterally connected between their ends by clips and tabs to form a linear group of spaced parallel tubes, which receive their vertical support by resting on a grid. The advantages of this method are that it permits elimination of structural material (e.g., fuel-element cans) within the reactor core, and removal of at least one fuel pin from an element and replacement thereof so that a burnable poison may be utilized during the core lifetime. (AEC)

36918 FUEL ELEMENT FOR A NEUTRONIC REACTOR. Robert K. McGeary and R. Winslow (to U. S. Atomic Energy Commission). U. S. Patent 3,105,030. Sept. 24, 1963.

A fuel element is described that is comprised of a plurality of fuel pellets securely held by the walls of a cladding tube. The fuel pellets are inserted in the cladding tube and the tube stretched until it grips the pellets and necks down between each individual pellet thereby separating the pellets by a predetermined amount. (auth)

36919 CONSTRUCTION OF NUCLEAR FUEL ELEMENTS. Sterling J. Weems (to U. S. Atomic Energy Commission). U. S. Patent 3,105,035. Sept. 24, 1963.

A rib arrangement and an end construction for nuclear-fuel elements laid end to end in a coolant tube are described. The rib arrangement is such that each fuel element, when separated from other fuel elements, fits loosely in the coolant tube and so can easily be inserted or withdrawn from the tube. The end construction of the fuel elements is such that the fuel elements when assembled end to end are keyed against relative rotation, and the ribs of each fuel element cooperate with the ribs of the adjacent fuel elements to give the assembled fuel elements a tight fit with the coolant tube. (AEC)

36920 PRESSURIZED WATER REACTOR CORE WITH PLUTONIUM BURNUP. K. H. Puechl (to U. S. Atomic

Energy Commission). U. S. Patent 3,105,036. Sept. 24, 1963.

A pressurized water reactor is described having a core containing Pu^{240}, in which the effective microscopic neutron-absorption cross section of Pu^{240} in unconverted condition decreases as the time of operation of the reactor increases, in order to compensate for loss of reactivity resulting from fission product buildup during reactor operation. This means serves to improve the efficiency of the reactor operation by reducing power losses resulting from control rods and burnable poisons. (AEC)

36921 CONCENTRIC TUBE FUEL ELEMENT SPRING ALIGNMENT SPACER DEVICE. Sterling J. Weems (to U. S. Atomic Energy Commission). U. S. Patent 3,105,037. Sept. 24, 1963.

A rib construction for a nuclear-fuel element is described, in which one of three peripherally spaced ribs adjacent to each end of the fuel element is mounted on a radially yielding spring that embraces the fuel element. This spring enables the fuel element to have a good fit with a coolant tube and yet to be easily inserted in and withdrawn from the tube. (AEC)

Power Reactors

36922 (ACNP-63023) PATHFINDER ATOMIC POWER PLANT. END CLOSURE DEVELOPMENT FOR LOW ENRICHMENT SUPERHEATER FUEL RODS. R. A. Boschke and R. J. Wiggins (Allis-Chalmers Mfg. Co. Atomic Energy Div., Milwaukee). July 30, 1963. For Northern States Power Co., Minneapolis, and Central Utilities Atomic Power Associates. Contract AT(11-1)-589. 43p.

Research on a welding process for closing the ends of pathfinder fuel elements is reported. Optimum parameters for certain variables (amperage, weld travel, preheat, etc.) affecting weld quality were determined, and two modified end cap designs were investigated and found to reduce weld sensitivity to certain variables. Use of chills on the fuel tube greatly improved weld puddle geometry and microstructure. Optimum weld parameters for rods containing UO_2 fuel were experimentally established. (D.C.W.)

36923 (ACNP-63518(Rev.1)) REPORT ON OPERATION OF THE ELK RIVER REACTOR. Topical Report No. 1. Initial Startup and Testing at Atmospheric Pressure for the Period from November 1, 1962 to January 20, 1963. (Allis-Chalmers Mfg. Co. Atomic Energy Div., Milwaukee). June 24, 1963. Revised Aug. 21, 1963. Contract AT(11-1)-589. 44p.

The following items are described: approach to initial criticality, methods and results of tests and measurements, equipment performance, radiation safeguards and radioactive waste disposal, water chemistry, and operating procedures and safety practices. Initial criticality was achieved on Nov. 19, 1962, with 41 elements in the core. The following characteristics were measured: temperature coefficient of reactivity, reactivity shutdown margin, control-rod worth, effective multiplication factor, flux distribution, and optimum fuel loading. (D.L.C.)

36924 (ANL-6682) A COMPARISON OF EXPERIMENTAL AND CALCULATED PROMPT NEUTRON LIFETIMES AND CENTRAL REACTIVITY COEFFICIENTS IN ZPR-III ASSEMBLIES AND THEIR RELATIONSHIP TO OTHER REACTOR PARAMETERS. W. G. Davey (Argonne National Lab., Idaho Falls, Idaho). June 1963. Contract W-31-109-eng-38. 39p.

Experimental parameters of ZPR-III fast reactor assemblies were compared with those calculated through use of a cross-section set derived from that of Yiftah, Okrent, and Moldauer, and initially used for a study of the critical sizes of ZPR-III assemblies. This cross-section set was also used to study central fission ratios in ZPR-III assemblies. The analysis was extended to prompt neutron lifetimes and the relative reactivity effects of the substitution of materials at the reactor centers. The results of the work were examined in conjunction with those of the critical size and fission ratio studies. (auth)

36925 (DLCS-5000763) MONTHLY OPERATING REPORT [ON PWR OPERATIONS], JULY 1963. (Duquesne Light Co., Shippingport, Penna.). Contract AT(11-1)-292. 55p.

A detailed report is given of the operation, performance, and other activities of the Shippingport Atomic Power Station. The reactor was shutdown for testing and maintenance. Incidents, chemistry, health physics, maintenance, test program, training program, and construction work all are discussed in detail. On August 1, 1963, the reactor reached a Core 1 electrical output of 1,613,741,500 kwh. (D.L.C.)

36926 (GAMD-3977(Rev.1)) PEACH BOTTOM HTGR EMERGENCY COOLING ACCIDENT TEMPERATURES AND THERMAL RELEASE OF NUCLEAR POISONS AND RADIOACTIVE NUCLIDES. J. A. Landoni and T. R. Moffette (General Atomic Div., General Dynamics Corp., San Diego, Calif.). June 25, 1963. Contract AT(04-3)-314. 107p.

Analysis is made of the temperatures and release of fission products and poisons from the core in a postulated incident in the Peach Bottom power station which poses the greatest potential radiological hazard. This incident, designated as Emergency Cooling Accident, involves the loss of forced circulation cooling in both main loops, permitting heat removal only by the emergency cooling water coils that line the reactor cavity. The primary coolant system is assumed to have ruptured in a non-isolable location. Analysis is also made of permissible delay in the startup of the Emergency Cooling System. (D.L.C.)

36927 (GEAP-4075) NUCLEAR SUPERHEAT PROJECT TWELFTH QUARTERLY REPORT, APRIL–JUNE 1962. R. T. Pennington (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.). Contract AT(04-3)-189. 226p.

The design study of a 600 Mw(e) boiling water-separate superheat reactor plant is summarized. The reactor is a single cycle, forced circulation with internal steam separators, 1075 psi, 1200 Mw(t). The superheat core is in a separate pressure vessel. It is a single pass with rod fuel, 965 psi, 950°F exit steam temperature. The fabrication of ESH-1 is complete. The design of ESH-2 is completed and fabrication has begun. The elements are to be tested with different claddings. An evaluation is made of the 300 series stainless steels as cladding material for fuel elements. With respect to coolant testing of claddings, Inconel's performance is greatly superior to types 304 and 347 stainless steels. Observations on the flow in the full-circle radial-vane separator were made in the air-water test loop at flow rates about equivalent to those in the 300 Mw(e) separate superheat reactor. Excessive droplet formation outside the vanes was observed. SH-4D was irradiated in the VBWR. The design data for all SADE fuel elements are summarized. Installation of the E-SADE loop was completed and a non-fueled checkout of the system was started. The cross section of the 75 Mw(e) prototype MSSR has had its fast core changed from square to round and the fuel changed from square to hexagonal. The design and fabrica-

tion effort for the Mixed Spectrum Superheat Critical Experiment (MSSCE) is proceeding on schedule. (N.W.R.)

36928 (GEAP-4126) NUCLEAR SUPERHEAT PROJECT THIRTEENTH QUARTERLY REPORT, JULY–SEPTEMBER 1962. R. T. Pennington (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.). Contract AT(04-3)-189. 206p.

The design study of a 600 Mw(e) boiling water-separate superheat reactor plant was completed. In addition a refueling accident was investigated and summarized. A parametric evaluation of fuel bundle bowing produced by nonuniform cladding temperature is summarized. Irradiation of the first fuel loading, ESH-1, for the E-SADE loop began. The BONUS fuel element was tested in preparation to being placed in the ESH-2 assembly. Metallographic examination of the NUSU cladding, Inconel X and type 347 stainless steel, revealed no localized corrosion attack on either material. No leak in the NUSU cladding was found. The effect of a superheat environment on the mechanical properties of Hastelloy X, Incoloy, and Inconel is shown. The additional effect of radiation is also shown. Corrosion testing in boiling $MgCl_2$ showed Hastelloy X and Inconel 625 to be the most resistant to the corrosion attack. Strain cycle results for nickel alloys at 1300°F are shown. Cycle and corrosion tests with heat transfer were run on Incoloy, Hastelloy X, and type 406 stainless steel. Further redesign of the CL-1 facility has begun with the goal of raising the steam temperature to 1150°F and clad temperature to 1400°F. Results are given for a series of air-water tests of the full-circle radial-vane separator showing the detailed flow on the vessel wall simulator at different air and water flow rates, different water level, and with 6 or 12 nozzles. The design conditions for ESH-2 are given. Work was initiated on a more detailed description of the long range Mixed Spectrum Superheat Reactor aiming toward a 500 Mw(e) plant. The conceptual design of the MSCA was completed. The development program for MSCA is described. (N.W.R.)

36929 (GEAP-4243) NUCLEAR SUPERHEAT PROJECT FIFTEENTH QUARTERLY REPORT, JANUARY–MARCH 1963. W. L. Fiock (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.). May 15, 1963. Contract AT(04-3)-189. 161p.

Failed tubes in the E-SADE loop condenser forced shutdown of the loop and removal of ESH-1.1 from VBWR. Post-irradiation examination of rod F showed that the failure of the type 304 stainless steel clad on ESH-1.0 was of the severe, localized, branched, intergranular corrosion similar to previous failures. Metallographic examination of element B (Incoloy) of ESH-1.0 has shown the clad to be in excellent condition. The design of element ESH-3 was initiated. This element is to serve as a screening prototype of the EVESR Mark III fuel. Property studies of Incoloy continue to be favorable. Results are presented for coupons of Inconel, Incoloy, and Hastelloy X exposed to simulated superheated steam environments. Types 304 and 316 stainless steels have experienced failures in the cycle tests with 0.5 ppm chloride added as $FeCl_3$ in the circulating water. Failure of the type 316 stainless steel coil in the CL-4 desuper-heater-reflux steam generator affected the test conditions of possibly three previous runs. Type 304 stainless steel and Incoloy corrosion tests in CL-4 loop are reported. Fission gas activity was measured on E-SADE inlet and outlet steam during operation. Air-water and steam-water tests of the full-circle radial-vane separator, without the area reduction sleeve, were conducted. A vane capacity of 5500 ft^3/hr was obtained with low carryunder and low carryover. Fabrication of the Mixed Spectrum Critical Experiment is 85% complete. The development program for the MSSCE is described. (N.W.R.)

36930 (TID-19267) LARGE REACTOR STUDY FOR SEA WATER DISTILLATION. Final Report. (Bechtel Corp., San Francisco). July 1963. Includes Appendices A through F. Contract AT(04-3)-507. 271p.

The results of a study of large nuclear reactor systems for supplying energy for the distillation of sea water are presented. The reactor types and sizes studied include: one 1500-Mw(t) light-water reactor of current technology; three 1500-Mw(t) light-water reactors in a single plant; one 3220-Mw(t) light-water reactor; one 3500-Mw(t) heavy-water-moderated, organic-cooled reactor; one 3500-Mw(t) graphite-moderated, light-water-cooled reactor; one 8300-Mw(t) heavy-water-moderated, organic-cooled reactor; a multi-unit 25000-Mw(t) station with high conversion ratio reactors; a 25000-Mw(t) station using an unspecified number of slightly enriched reactors; and an unspecified number of fast breeder reactors of 25000-Mw(t) total capacity. A summary of technical design data is presented. Costs for all cases were calculated and translated into annual costs. (M.C.G.)

36931 (WAPD-MRP-93) PRESSURIZED WATER REACTOR (PWR) PROJECT TECHNICAL PROGRESS REPORT FOR THE PERIOD JUNE 24, 1961 TO AUGUST 23, 1961. (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Contract AT-11-1-GEN-14. 119p.

Development and operation of the Shippingport Pressurized Water Reactor is reported. Topics covered include: plant modification, plant decontamination, reactor engineering, metallurgy of core materials, core operations, and reactor physics. (N.W.R.)

36932 (WAPD-MRP-104) PRESSURIZED WATER REACTOR (PWR) PROJECT. Technical Progress Report, April 24, 1963–June 23, 1963. (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Contract AT(11-1)-Gen-14. 121p.

Development and operation of the Shippingport Pressurized Water Reactor is reported. Topics covered include: plant modification, plant decontamination, reactor engineering, metallurgy of core materials, core operations, and reactor physics. (N.W.R.)

36933 (WAPD-PWR-1606(Add.1)) THE SHIPPINGPORT PRESSURIZED WATER REACTOR PROJECT CATALOG OF DOCUMENT ABSTRACTS. (Westinghouse Electric Co. Bettis Atomic Power Lab., Pittsburgh). May 1963. Contract AT(11-1)-Gen-14. 49p.

About 190 abstracts are presented of reports pertaining to the Shippingport PWR project that were issued since December 1961. The abstracts are arranged in sections entitled Chemistry, Core Development, Physics, Reactor Engineering, Power Plant, Metallurgy, General, Progress Reports, and Duquesne Light Company Test Results. A report number index is included. (D.L.C.)

36934 (WAPD-TM-326) EXAMINATION OF PWR CORE 1 BLANKET FUEL RODS FOR MICROSTRUCTURE CHANGES, HYDROGEN PICKUP, BURST STRENGTH, AND FISSION GAS RELEASE AT THE END OF THE SECOND SEED LIFE. L. R. Lynam (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Apr. 1963. Contract AT(11-1)-Gen-14. 31p.

PWR blanket fuel rods have completed their second seed life of approximately 13,700 EFPH. Upon the completion of the metallurgical evaluation it was observed that there were no significant changes in rod dimensions, fuel or sheathing microstructure, or average fission gas release and that it

compares favorably with the data obtained at the end of the first seed life. Hydrogen pickup of the Zircaloy-2 sheath is consistently low, and extrapolation of all data shows that no adverse effects are anticipated in the performance of the blanket fuel rods during Seed 3 life. (auth)

36935 OPERATING EXPERIENCE WITH POWER REACTORS. A. Das Gupta (International Atomic Energy Agency, Vienna). Atompraxis, 9: 297-301(Aug. 1963). (In English)

A detailed review is given of the International Scientific Conference on Operating Experience with Power Reactors in the first week of June 1963 in Vienna. (auth)

36936 POWER REACTORS AND THEIR ECONOMIC FEASIBILITY. F. Flick (Deutschen Atomforum ev, Bonn). Atompraxis, 9: 301-3(Aug. 1963). (In German)

Problems in reactor construction in West Germany, and the technical risks and possibilities involved in calculating their economic feasibility, are discussed in comparison with the situation in other countries. (auth)

36937 NUCLEAR POWER STATION DEVELOPMENT IN BRITAIN. R. V. Moore (United Kingdom Atomic Energy Authority, Risley, Warrington, Eng.). Atompraxis, 9: 303-11(Aug. 1963). (In English)

The development of graphite-moderated CO_2-gas cooled reactors in Britain is described. The development of the advanced gas-cooled reactor and the use of special-clothing fuel elements, covering both the "Magnox" and the "AGR" versions of this system, as well as the discussion about the cost for the electricity in comparison with the coal-fired stations are reviewed. (auth)

36938 AN ECONOMIC BREED OF POWER REACTORS IN THE USA. F. K. Pittman (Atomic Energy Commission, Washington, D. C.). Atompraxis, 9: 311-17(Aug. 1963). (In English)

A survey of the United States Atomic Energy Commission's nuclear power program is presented. Reactor concepts, and reactors, with vigorous objectives in short- and long-range economy are discussed. (auth)

36939 THE HIGH TEMPERATURE GAS-COOLED REACTOR. T. Le Clair (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Atompraxis, 9: 317-22(Aug. 1963). (In English)

In describing the system of HTGR, the advantages and corollary economic dividends for power producing are discussed. Prototype plant development, the current status of the HTGR program, and power cost potential are reported. (auth)

36940 CLOSED CYCLE WATER REACTORS— THE PROVEN APPROACH TO ECONOMIC NUCLEAR POWER. G. H. Farbman and J. N. Kilpatrick (Westinghouse Electric Corp., Pittsburgh). Atompraxis, 9: 322-7(Aug. 1963). (In English)

The major operating and economic advantages of closed-cycle water reactors are described. They are based on proven reliability, complete safety of operation, low power production costs, and competitiveness with fossil fuel plants. (auth)

36941 BR3: FIRST BELGIAN NUCLEAR POWER STATION. PART 2. R. Doyen. Electricite, No. 110, 33-56(Apr. 1963). (In French)

Details are given of the primary circuit, heat exchanger, secondary circuit, purification circuit, and safety and boron injection circuits. Various individual items of the plant such as the reactor pressure vessel, core control rods, and pumps are also discussed. The principal characteristics of the station that will have a net output of 10.6 Mw(e) are listed. (OTS)

36942 METHOD OF DETERMINING THE "SANITARY ZONE" AROUND LARGER THERMAL POWER STATIONS. V. G. Zhilin. Elekt. St., 34: No. 4, 26-8(Apr. 1963). (In Russian)

The maximum concentration of impurities permitted at ground level at any distance from the flue-gas stack is fixed by health requirements at 0.5 mg/m^3. Where this figure would be exceeded by the construction of a new station, an area unsuitable for habitation has to be designated. A method for determining this area is presented. An example is worked for a proposed station with eight 300 Mw sets, burning anthracite fires, for the case where the stack is 300 m high and 250 m high. The rate of flue-gas emission at full load is 50 m/sec and the yearly average wind speed is 4.5 m/sec. It was found that in case of a 300 m high stack, no zone need be designated, and for a 250 m stack the zone would extend over an area of radius 7750 m. (TCO)

36943 AN ASSESSMENT OF GAS-COOLED REACTORS. Engineer, 468-72(Mar. 15, 1963).

The assessment is based on a reference design for a station of two reactors each of 500 Mw net electrical output. The core and boiler tubes are enclosed in a prestressed concrete pressure vessel. Assuming a program of commercial stations based on the reference design (and assuming load factor 75%, amortization twenty years, interest 6%) the cost of generation is estimated to be less than 0.5 d/kwh. Engineering developments could reduce this figure to 0.35 d/kw. Further advances, such as the elimination of fuel canning and the adoption of higher fuel surface temperatures are envisaged. (TCO)

36944 NUCLEAR POWER TODAY. Chauncey Starr. Intern. Sci. Technol., No. 22, 32-42(Oct. 1963).

The development of nuclear power stations is reviewed. Five types of reactors have emerged as the principal contenders for full-scale electric power generation. These are: the pressurized-water, the closely related boiling-water, the heavy-water-moderated organic-cooled, the gas-cooled graphite-moderated, and the sodium-cooled graphite-moderated. Plutonium production in power reactors, the power-producing process, efficiency, comparative economics, and safety are discussed. (M.C.G.)

36945 THE SELF-REGULATING CAPABILITY OF POWER REACTORS. H. Wundt (EURATOM, Ispra, Italy). Nukleonik, 5: 208-13(Aug. 1963). (In German)

The stationary treatment of kinetic equations, together with some equations for heat transport, led to a linear algebraic equation system, whose solution gives the change of power and temperature after changes of reactivity, coolant inlet temperature, the flow through, or several of the changes at the same time. Hereby, a certain necessary, but not sufficient, stability condition was noticed. The discussion of individual cases showed that only a very slight chance exists for power control without artificial reactivity interference, for example without control rods. (tr-auth)

36946 THE STORY OF THE CONSTRUCTION OF BERKELEY NUCLEAR POWER STATION. John Hall. London, Leonard Hill (Books) Ltd., 1963. 96p.

An outline of the designing and planning that went into the construction of the Berkeley nuclear power station is presented. Topics considered were the graphite-moderated gas-cooled reactor, the biological shield, pressure vessel, boilers, ducting, graphite laying, thermocouples, burst cartridge detection equipment, installation of control rods,

charge face machinery, reactor commissioning, fuel load and testing, the cooling pond, fuel element storage, the cooling system, the turbine hall, and main control room. Numerous illustrations are included. (C.E.S.)

36947 BOILING NUCLEAR SUPERHEATER (BONUS) BUILDING (Engineering Materials). (Jackson and Moreland, Inc., Boston). (CAPE-1020)

This package contains 74 specifications and 172 drawings. The Puerto Rico Power Reactor is located in a containment structure that consists of a vertical cylinder with a hemispherical dome, which forms a shell with a clear inside dia. of 165 ft and a clear inside height of 107 ft at its zenith. The primary function of the containment structure is to contain the steam and radioactive materials released in case of a reactor auxiliary failure or reactor incident. The containment structure houses the nuclear reactor, turbine-generator, control room, and most of the associated equipment, systems, and service rooms of the nuclear power station. The structure is designed for a low pressure of 5 psig and is fabricated of $\frac{3}{8}$ in. thick steel. The reactor pressure vessel, surrounded by a steel tank which contains iron-water as a thermal shield and a biological shield, is constructed of 9 ft thick concrete. Adjacent to the reactor is a fuel storage pool. The elevation of the operating floor of the structure is 37 ft 4 in. The control room, machine shop, offices, laboratories, and shops are located on this floor. (F.L.S.)

36948 TRENDS IN DESIGN AND COSTS OF HEAVY WATER MODERATED NUCLEAR POWER PLANTS. L. R. Haywood (Atomic Energy of Canada Ltd., Toronto). 19p. (CONF-9-27)

From Canadian Nuclear Association, International Conference and Future Development of Power Reactors and on Radioisotopes, Montreal, May 1963.

The heavy-water-moderated nuclear power stations of the mid 1970's are identified and the capital and operating costs of such stations are forecast. It is postulated that 80% of the heavy-water-moderated stations built in the mid 70's will utilize reactors producing 1000 Mw(t) or more. Power costs, assuming a fixed charge rate of 6.5% and construction in Canada, for multi-reactor stations wherein each reactor produces the thermal power necessary for generation of about 500 Mw(e) (net) will be 3.5 ± 10% mills per kwh exclusive of any allowance for escalation during the operating period. Design trends, cost trends, and target capital costs for coal-fired stations are discussed. (M.C.G.)

36949 MANUFACTURING THE STEAM GENERATORS FOR DOUGLAS POINT. R. L. Grassby (Montreal Locomotive Works, Ltd.). 22p. (CONF-9-28)

From Canadian Nuclear Association, International Conference and Future Development of Power Reactors and on Radioisotopes, Montreal, May 1963.

The design and manufacture of steam generators for the Douglas Point Nuclear Power Station are described. The project consisted of 80 heat exchangers and 8 steam drums. The drum, heat exchanger shells, and interconnecting piping, including headers, were fabricated from carbon steel; the heat exchanger tube sheets and the 195 tubes in each heat exchanger were made from Monel. The wet steam is purified before it leaves the drum on its trip to the turbine by use of 16 centrifugal type purifiers. Tube welding procedures are described. (M.C.G.)

36950 THE FUTURE OF LARGE REACTORS. J. C. Rengel, W. L. Budge, and J. C. Gray (Westinghouse Electric Corp., Pittsburgh). 21p. (CONF-51-3)

From American Public Power Assn., Convention, Cleveland, Apr.-May 1963.

The future of large reactors is tied closely to the future requirement for very large generating units. The development of power pools and interconnected systems assures a market for very large units, and the rapid development of nuclear technology assures that the nuclear industry will be able to meet the demand for units in the 1000-Mw range. The closed cycle water reactor will meet the demands for large plants in the foreseeable future. The superheat concept is expected to be ready for use in the late 1970's. Beyond that, the fast breeder reactor will almost certainly come into the picture. (A.G.W.)

36951 BOILING WATER REACTOR NUCLEAR POWER PLANTS. H. L. Stewart (General Electric Co., San Jose, Calif.). 10p. (CONF-51-2)

From American Public Power Assn. Convention, Cleveland, Apr.-May 1963.

Features incorporated in the boiling water reactor power plants offered to the utility industry by General Electric are summarized. Plants operated and under construction by G. E. are listed. Power cost, plant reliability, and construction time required are discussed briefly. (A.G.W.)

36952 BIG ROCK POINT NUCLEAR PLANT INITIAL APPROACH TO POWER. R. L. Haueter (Consumers Power Co., Jackson, Mich.) and L. M. Hausler. 23p. (CONF-15-4)

From American Power Conference Meeting, Chicago, Mar. 1963.

The Big Rock Point Nuclear Plant is a boiling water, direct cycle, forced circulation, high power density nuclear reactor facility with an initial electrical capacity of 50 Mw, equivalent to a reactor thermal capacity of 157 Mw. The plant is described and data on the reactor core and controls are tabulated. Preoperational acceptance testing, core loading, the power test program, and problems encountered in operation to date are reviewed. The reactor was first brought critical on Sept. 27, 1962. Nuclear characteristics were within acceptable tolerances or readily corrected. Operating characteristics are improving rapidly as minor problems are solved. (A.G.W.)

36953 HIGHLIGHTS OF OPERATING EXPERIENCE DURING PAST YEAR AT YANKEE ATOMIC ELECTRIC COMPANY PLANT. L. E. Minnick (Yankee Atomic Electric Co., Boston). 7p. (CONF-15-7)

From American Power Conference Annual Meeting, Chicago, Mar. 1963.

During the first four months of 1962 the life of the first core was "stretched out" in order to reduce overall fuel cost. On Jan. 18 all control rods had been fully withdrawn, and on May 18 the plant was shut down for refueling. Several reactor components in addition to the core were replaced. Plant operation with the second core was begun in Sept. 1962 and a period of routine operation at full load followed. In Jan. 1963 station load was reduced in preparation for test operation with boric acid in the main coolant. The tests are still in progress. (A.G.W.)

36954 ORGEL PROGRAM. 251p. (CONF-143-1; EUR 101.e)

From Congress of the European Atomic Energy Society on the Fundamental Problems of Nuclear Power Plants Likely to be Built in the Next Ten Years, Cannes, France, Oct. 1962.

Parameter optimization studies for an ORGEL power plant are reported, and the ESSOR test reactor used in the program is described. Research at Ispra in reactor physics,

technology, metallurgy, heat transfer, chemistry, and physical chemistry associated with ORGEL development is also summarized. (D.C.W.)

36955 CONTROLLING RAPID LOAD CHANGES ON THE BOILERS OF A LARGE POWER SYSTEM. C. W. Kellstedt (Consolidated Edison Co. of New York, Inc., New York). 16p. (CONF-91-1).

From National Power Instrumentation Symposium, Philadelphia, May 1963.

In order to satisfactorily control rapid load changes on the boilers of a large power system a great deal of careful long range planning is required. An accurate prediction of system load growth must be made, and the characteristics of the daily load curve must be studied in order to determine the number, size, and type of units that must be installed to meet the load demands. As part of this planning, careful consideration must be given to the adequacy of inter-station ties as well as the capacity of the interconnections with other systems in order to determine the effect of the expected load changes on the generating station equipment. The methods and equipment used by Consolidated Edison Company of New York to control the normal daily load changes, and how the generating stations respond to the trip out of one of the large units, are described. The engineering specifications used to obtain the necessary flexibility in a combustion, feedwater, and steam temperature control system for a 1,000,000 kilowatt steam generator, as well as some of the control design features, are also described. The part played in control by nuclear steam generators is also discussed. Some of the design features of the Con Edison Indian Point Nuclear Plant are described and attention is given to the controls for the reactor and associated boilers. Emphasis is placed on the inherent characteristics of response of this pressurized water reactor and how they influenced the control system design. (auth)

36956 SOME TECHNICAL PROBLEMS OF WATER-TO-WATER POWER REACTORS. Vladimir A. Sidorenko. 7p. (CONF-9-23)

From Canadian Nuclear Association, International Conference and Future Development of Power Reactors and on Radioisotopes, Montreal, May 1963.

Prospects and problems of developing water-water reactors are discussed. The Novo-Voronezh APS reactor is described. Methods of increasing reactor power, performance of sintered UO_2 fuel elements, the control and safety system, and possible modifications to primary circuit and auxiliary systems are discussed. (M.C.G.)

36957 OPERATION EXPERIENCE OF THE FIRST ATOMIC POWER STATION. G. A. Kotchetkov. 14p. (CONF-9-25)

From Canadian Nuclear Association, International Conference and Future Development of Power Reactors and on Radioisotopes, Montreal, May 1963.

Operation of the first atomic power station in the USSR is discussed. The graphite-water power reactor with fuel U-type channels is described. Data are presented in tables. (M.C.G.)

36958 FIRST NPD FUEL CHARGE, PRESENT PERFORMANCE AND BASIS FOR CONTINUED CONFIDENCE. A. J. Mooradian (Atomic Energy of Canada Ltd., Chalk River, Ont.). 24p. (CONF-9-24)

From Canadian Nuclear Association, International Conference and Future Development of Power Reactors and on Radioisotopes, Montreal, May 1963.

The performance of the NPD fuel charge is discussed and data are presented that suggest that design burnup should be achieved without difficulty. All 132 channels of NPD are identical in dimensions and are capable of accepting the same design of fuel. However, as a measure of economy, the first core was split into two zones. The inner zone of 52 channels in charged with 19-element bundles of Zircaloy-clad UO_2. The outer zone of 80 channels is loaded with 7-element bundles. Depleted uranium is used to take up excess reactivity at startup and to balance the reactor for optimum performance. This is achieved economically by scattering bundles loaded with depleted uranium at appropriate sites throughout the reactor. The reactor has operated a total of 108.5 equivalent full power days based on a plant output of 22 Mw(e). The burnup of the hottest bundle is calculated to be 1.815 Mwd/t U. (M.C.G.)

36959 OPERATING EXPERIENCE WITH BOILING WATER REACTORS. John Barnard (General Electric Co., San Jose, Calif.). 8p. (CONF-9-29)

From Canadian Nuclear Association, International Conference and Future Development of Power Reactors and on Radioisotopes, Montreal, May 1963.

The performances of the Vallecitos Boiling Water Reactor Power Plant, the Dresden Nuclear Power Station, the RWE (Kahl) Nuclear Power Plant, the Big Rock Point Nuclear Plant, and the Humboldt Bay Power Plant Unit #3 are described. Experience gained in the operation of these plants is summarized. (M.C.G.)

36960 THE PERFORMANCE OF NUCLEAR STRUCTURAL MATERIALS FOR POWER REACTORS. W. R. Thomas (Atomic Energy of Canada Ltd., Chalk River, Ont.). 18p. (CONF-9-22)

From Canadian Nuclear Association, International Conference and Future Development of Power Reactors and on Radioisotopes, Montreal, May 1963.

The results of studies made to determine the design parameters and the long-term behavior of core materials in a reactor environment are summarized. Components for the NPD and CANDU reactors were considered. It was found that the pressure tube design stress in both NPD and CANDU is well within a factor of 4 of the ultimate strength of the pressure tubes after a short time of operation. It was concluded that directional hydriding will not be a problem in NPD. The reactor core components of NPD caused no difficulty, whereas the performance of the standard components indicated that more attention should be paid to the quality and fabrication of standard components. (M.C.G.)

36961 IMPROVEMENTS IN OR RELATING TO A NUCLEAR POWER PLANT. (to General Dynamics Corp.). British Patent 931,930. July 24, 1963. Priority date Feb. 10, 1960, United States.

A heat-extraction system for a gas-cooled reactor is patented. The system is composed of a heat exchanger, a concentric gas-carrying duct between the heat exchanger and the reactor, a gas-turbine unit within the inner duct, and a compressor in the outer duct. The rotor and stator blades of the turbine are driven by the heated gas passing from the reactor to the heat exchanger. The rotor and stator blades of the compressor are formed integrally with the blades of the turbine and are driven simultaneously with the turbine blades. This compresses the coolant gas passing through the outer duct, providing the necessary circulation rate to sustain the turbine and compressor in a free-running state. (M.P.G.)

Production Reactors

36962 (HW-76549) PLUTONIUM RECYCLE CRITICAL FACILITY CRITERIA FOR LIGHT WATER-MODERATED EXPERIMENTS. V. W. Gustafson (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). [Mar. 7, 1963]. Contract [AT(45-1)-1350]. 10p.

Included are outlines of the experimental program and safety requirements for the water-moderated studies to be carried out in the PRCF, which provide a basis for establishing safe design and safe operating limits and procedures for the program. Type I experiments consist of fuel elements of 2 to 4 feet, while Type II experiments involve fuel elements of 4 to 8 feet in length. The criteria presented are concerned with Type I experiments. (B.O.G.)

36963 DOUNREAY EXPERIMENTAL FAST BREEDER REACTOR. Eng. Boiler House Rev., 77: 430-4(1962).

A review is presented on the Fast Breeder reactor at Dounreay. Reactor power was first raised to 30 Mw in August 1962, but after a run at this output it became time for some of the fuel elements to be examined and for some minor adjustments to be made to the reactor itself. The power was again raised and later sufficient steam was available to begin operating the associated turbine generator set. (TCO)

36964 NEUTRONIC REACTION SYSTEM. Eugene P. Wigner (to U. S. Atomic Energy Commission). U. S. Patent 3,102,851. Sept. 3, 1963.

A nuclear reactor system is described for breeding fissionable material, including a heat-exchange tank, a high- and a low-pressure chamber therein, heat-exchange tubes connecting these chambers, a solution of U^{233} in heavy water in a reaction container within the tank, a slurry of thorium dioxide in heavy water in a second container surrounding the first container, an inlet conduit including a pump connecting the low pressure chamber to the reaction container, an outlet conduit connecting the high pressure chamber to the reaction container, and means of removing gaseous fission products released in both chambers. (AEC)

36965 REACTOR. Leo Szilard (to U. S. Atomic Energy Commission). U. S. Patent 3,103,475. Sept. 10, 1963.

A breeder reactor is described, including a mass of fissionable material that is less than critical with respect to unmoderated neutrons and greater than critical with respect to neutrons of average energies substantially greater than thermal, a coolant selected from sodium or sodium–potassium alloys, a control liquid selected from lead or lead–bismuth alloys, and means for varying the quantity of control liquid in the reactor. (AEC)

Research Reactors

Refer also to abstract 35868.

36966 (AERI-E/R-1) TRIGA MARK II TRANSFER FUNCTION MEASUREMENT AND THE DYNAMIC ANALYSIS. In Yong Park (Atomic Energy Research Inst., Seoul). Sept. 20, 1962. 30p.

The zero and reactor power transfer functions of the TRIGA Mark II reactor were measured by the reactor oscillation technique at 50 w and 1 and 50 kw, respectively. Temperature feedback effects were observed at the 50 kw power level. The measured functions are compared with the analytically derived transfer function of the reactor, and fundamental information on the reactor kinetics (neutron lifetime in the system, temperature feedback effect, etc.) is derived. (auth)

36967 (AERI-P/R-6) PILE OSCILLATOR FOR THE MEASUREMENT OF NEUTRON ABSORPTION CROSS SECTIONS. H. I. Park, I. K. Kim, and B. K. Yoon (Atomic Energy Research Inst., Seoul, Korea). Dec. 31, 1962. 10p.

A local type pile oscillator designed and constructed at the Atomic Energy Research Institute, Republic of Korea, is described. A specimen and a standard mounted on a rod are oscillated through a cylindrical ion chamber located in the thermal column of the Triga Mark II reactor, and the current depressions from the ion chamber are compared to give the neutron absorption cross section of the specimen. Neutron sensitive ion chambers were constructed with two and three aluminum cylinders coated with boron, and the first chamber gave a saturation current of 5 microamp at a 100 kw reactor power. Neutron absorption signals from the ion chamber are integrated after being amplified by a narrow-band r-c amplifier, whose maximum gain was 13,000. An integrated signal of the neutron absorption by a 4 gram cadmium plate read 5 microamp after 40 oscillations, and that by a 1 gram gold foil read 0.2 μamp. The original integrator circuit was modified to increase the output 40 times. (auth)

36968 (AID-P-63-14) SOVIET NUCLEAR RESEARCH REACTORS: VVR-S (MOSCOW) AND VVR-S (TASHKENT). Review of Soviet Literature. AID Work Assignment No. 31. (Library of Congress, Aerospace Information Div., Washington, D. C.). Jan. 21, 1963. 12p. (AD-295989)

A description is given of the two Soviet water-moderated water-cooled reactors (VVR-S), one of which is located in Moscow and the other in Tashkent, Uzbekskaya SSR. The VVR-S reactors, intended for experimental and research purposes, were developed from the experimental enriched-uranium VVR reactor. Background information, general construction details, features of the control and safety systems, and information on the experimental facilities afforded by the reactor are presented. (auth)

36969 (IDO-16894) ETR FLUX MEASUREMENTS FOR CYCLES 51B AND 54. L. D. Weber and C. H. Hogg (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). July 15, 1963. Contract AT(10-1)-205. 69p.

The thermal-neutron fluxes in the lattice positions and selected experimental positions of the ETR were measured for Cycle 51B. Gamma heat generation was also measured in various experimental positions for Cycles 51B and 54. Vertical traverses for each position monitored are shown. (auth)

36970 (IDO-16899) A PRELIMINARY REPORT OF BERYLLIUM DAMAGE OBSERVED IN THE MTR REFLECTOR. J. W. Dykes and J. D. Ford (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). June 20, 1963. Contract AT(10-1)-205. 16p.

Evidence of bowing was observed in an MTR beryllium shim rod section during the Cycle 184 shutdown. Inspection and measurements of this and other selected beryllium lattice pieces confirmed this observation. Preliminary measurements were made along a vertical transverse between the north and south reflector walls with some bowing again noted. An inspection of the north wall revealed cracking and spalling of the beryllium sections, primarily in the vicinity of the HB-2 thimble. (auth)

36971 (JAERI-Memo-1122) TCA CRITICAL EXPERIMENTS AND CHARACTERISTIC MEASUREMENTS.

Yutaka Hirota, Yuzo Endo, Shojiro Matusuura, et al. (Japan. Atomic Energy Research Inst., Tokyo). Jan. 20, 1963. 72p.

The Tank Type Critical Assembly (TCA) is being constructed parallel to the construction of Japan Power Demonstration Reactor. The initial fuel loading of TCA took place on Aug. 22, 1962, and successfully reached criticality the next morning. The records of this first criticality and the characteristic measurements done during the succeeding four months are presented. An outline of the preliminary critical calculation is given. (auth)

36972 (ORNL-3393) PERFORMANCE TESTS OF THE OAK RIDGE NATIONAL LABORATORY FAST SAFETY SYSTEM. J. R. Tallackson, J. B. Ruble, R. T. Santoro, and R. E. Wintenberg (Oak Ridge National Lab., Tenn.). Sept. 12, 1963. Contract W-7405-eng-26. 53p.

Tests were conducted to verify the performance of the Oak Ridge National Laboratory fast safety system. Safe operation of the Bulk Shielding Reactor II (BSR-II), a small pool-type reactor with an extremely short neutron lifetime (21×10^{-6} sec), requires a fast acting, reliable safety system, that is, a multichannel system in which all fixed-time delays are minimized and which features rapid insertion of the shim-safety rods. The shutdown characteristics of the reactor, with and without the safety system, were determined by a comprehensive series of tests of the BSR-II, at the Special Power Excursion Reactor Test Facility, National Reactor Test Station, Idaho Falls, Idaho. The reactor was subjected to power excursions of ever increasing violence. Test severity was limited to peak powers less than that which produced incipient damage to the core. Self-shutdown of a transient with a 0.014-sec stable period resulted in a peak power of 226 Mw and was accompanied by very slight core damage. The safety system employed both period ($\tau < 1$ sec) and flux level ($\phi > 130$ kw) signals to scram the reactor. The reactor was operated without a source so that the stable periods of the transients were completely established in the submilliwatt power region which was below the range of the safety system. Therefore, the tests resulted in a very conservative evaluation of the performance of the safety system. Under these conditions, the period safety channels held BSR-II power to safe values for transient excursions with stable periods down to 0.003 sec. The flux level channels were equally effective in limiting excursions with periods down to 0.005 sec. The tests demonstrated that, in this reactor, a fast safety system is effective in counteracting substantial and rapid additions of prompt excess reactivity. A description is given of the safety system and its salient characteristics. Transient test procedure is reported in detail, test results are plotted and compared with calculated estimates, and general conclusions and recommendations are included. Data-reduction methods are outlined. (auth)

36973 THE OPERATION OF HIFAR TO MEET THE A.A.E.C. RESEARCH ESTABLISHMENT'S IRRADIATION PROGRAM. G. A. Tingate. At. Energy Australia, 6: No. 3, 16-19(July 1963).

Operation of the 10-Mw(t) high-flux reactor, HIFAR, is discussed. The factors that assure that HIFAR meets the irradiation program efficiently and economically are described under two headings: matching the available reactivity to the required reactivity and minimizing the shutdown time of the reactor. (M.C.G.)

36974 THE ROSSENDORF RING ZONE REACTOR (RRR)—AN INSTRUMENT FOR REACTOR PHYSICS RESEARCH. T. Kampf and P. Liewers (Zentralinstitut für Kernphysik, Rossendorf, Ger.). Kernenergie, 6: 300-5 (July 1963). (In German)

A general description is given of the zero-power reactor completed in Rossendorf in the past year. The use of the reactor for reactor physics studies is indicated. (tr-auth)

36975 MEASUREMENT AND CONTROL EQUIPMENT OF THE ROSSENDORF RING ZONE REACTOR. S. Menzel (Zentralinstitut für Kernphysik, Rossendorf, Ger.). Kernenergie, 6: 306-10(July 1963). (In German)

In order to assure safe and continuous operation of the RRR, its measurement and control equipment is relatively extensive. The most important source for the design was the knowledge gained in the operation of the WWR-S reactor. The measurement technology is based essentially on neutron flux measurements. Some conventional devices for measurement of the water level, flow-through, and temperatures complete the system. The control or shut-down of the reactor is effected by neutron absorbers arranged on the boundary of the fission zone. Operational safety is increased by a fast drainage of the moderator water. Electrical control circuits monitor the safety of the plant during shutdown and operation. (tr-auth)

36976 THE WATER SYSTEM OF THE ROSSENDORF RING ZONE REACTOR. H. Langenbrunner and K. Schwarz (Zentralinstitut für Kernphysik, Rossendorf, Ger.). Kernenergie, 6: 310-14(July 1963). (In German)

The specifications of the water system, both the mechanical construction and the involvement of the water circuit in the safety system, are described. The construction of the electrical pre-heating and the fast drain valves is considered. (tr-auth)

36977 LOGARITHMIC POWER CHANNEL WITH PERIOD METER. E. Adam and H. Lange (Zentralinstitut für Kernphysik, Rossendorf, Ger.). Kernenergie, 6: 320-6(July 1963). (In German)

The important magnitudes that characterize the transient operation of a reactor are the thermal power and the doubling time. A measurement device is described with which the reactor output can be measured continuously over 6 decades on an instrument with logarithmic divided scale. A second device measures the doubling time between +3 sec ... ∞ ... −3 sec. (tr-auth)

36978 SAFETY AMPLIFIER FOR THE ROSSENDORF RING ZONE REACTOR. A. Grossmann (Zentralinstitut für Kernphysik, Rossendorf, Ger.). Kernenergie, 6: 326-31(July 1963). (In German)

A safety amplifier constructed from semiconductor elements was developed for use in the Rossendorf ring-zone reactor. This device uses ionization currents from 3×10^{-9} to 1×10^{-4} amp in nine measurement ranges. In each measurement range the value was regulated 100% with a fine control. The alarm or safety circuit of the reactor was tested at 110 and 120%. According to specifications, the safety amplifier can be introduced into the reactor circuit only by hand. The feed voltage for the ionization circuit is also introduced in the safety circuit. (tr-auth)

36979 MEASUREMENT OF THE NEUTRON ABSORPTION CROSS SECTION OF THE MODERATOR IN THE WWR-S REACTOR. P. Liewers (Zentralinstitut für Kernphysik, Rossendorf, Ger.). Kernenergie, 6: 332-6(July 1963). (In German)

The problem of determining the absorption cross section of weakly absorbing materials in a reactor with small fission zone was reduced to the special problem of the measurement of the graphite absorption cross section.

Only the method of comparison with standards was used. The accuracy obtainable in the case of graphite lies in the order of magnitude of $\Delta\sigma_a = \pm 0.5$ mbarn. (tr-auth)

36980 MULTIZONE HETEROGENEOUS EXPERIMENTAL REACTOR. (to Siemens-Schuckertwerke AG). German Patent 1,110,770. July 13, 1961. Filed Aug. 27, 1959. Kernenergie, 6: 366(July 1963). (In German)

A heterogeneous multizone experimental reactor (any type moderator) built from a central reactor structure, with one mantel zone of enriched fuel elements arranged around it and at least one moderator material, is described. The principal problem in the correlation of experimental reactors with power reactors is the need for a simple manner of adjusting the neutron spectrum and the flux distribution of the experimental reactor proportional in intensity and distribution to the conditions in power reactors. The problem is solved in the present case by the use of enriched fuel elements in the mantel vertically adjustable with radially arranged drive mechanisms. If the elements are adjusted from outside, the layer thickness of the moderator liquid found between these elements and the periphery of the lattice is forcibly increased.

36981 ON THE APPLICATION OF UNCOOLED THERMAL SHIELDING FOR LOW-TEMPERATURE EXPERIMENTS IN REACTORS. W. Koeppe (Zentralinstitut fllr Reaktorexperimente der KFA, Julich, Ger.). Nukelonik, 5: 198-200(Aug. 1963). (In German)

The heat exchange by radiation between bodies or surfaces was considered, in which, at times, a body is completely surrounded. For given inner and outer temperatures, the shield temperature and the amount of heat conveyed to the (cold) inner body were calculated including the case in which the shield is also heated. A limiting condition for the source strength for heating the shield was given. The results were applied to a cryostat in a reactor channel. It is shown that the installation of an uncooled shield can decrease appreciably the cold requirements of the cryostat. (tr-auth)

36982 FAST BURST REACTOR—SPECIFICATIONS (ORNL) (Engineering Materials). (Nuclear Development Corp. of America, White Plains, N. Y.). (CAPE-1008)

This package contains 2 specifications. Specifications for fuel materials, neutron source, and rod drives describing the ORNL Fast Burst Reactor (FBR) are included in this package. The fuel materials, including control rods, safety block, burst rod, and bolts are of fully enriched U with Mo. All surfaces are plated with a layer of Ni not more than 0.005 in. thick. Surfaces that form the reactor exterior are clad with a 0.010 in. thick layer of Cd, or equivalent, neutron absorbing material. Specifications are available for the drives for the control rods, burst rod, safety block, and for the neutron source. The characteristics for the neutron source are described. For other materials describing the ORNL FBR, see CAPEs-900, 901, and 902. (R.E.C.D.)

SPACE APPLICATIONS AND TECHNOLOGY

Refer also to abstract 36347.

36983 (AD-290068) FEASIBILITY DETERMINATION OF A NUCLEAR THERMIONIC SPACE POWER PLANT. Quarterly Technical Progress Report, August 1, 1962 through October 31, 1962. (Aerojet-General Nucleonics, San Ramon, Calif.). Contract AF33(657)-8977. 22p. (AN-778)

A research program on thermionic converter-radiator systems is being conducted to demonstrate the operation of at least 3 thermionic converters in a series array using heat from a liquid metal loop, and to demonstrate 1000 hr of thermionic operation using liquid metal heating. For the electrical insulation of the thermionic units from the heating pipe, Al_2O_3 coatings plasma-sprayed on Nb tubes were developed. The effects of sintering experiments on the coatings were studied. The brazing of an outer Mo sleeve to the Mo coating plasma-sprayed over the Al_2O_3 was investigated using three braze materials and found to be satisfactory. The analysis for the thermal radiator system for its characteristics and for design and development problem areas is discussed. Finally, progress on the loop test task is described. (D.L.C.)

36984 (AD-295100) DESIGN CRITERIA FOR RADIATION RESISTANT FLIGHT CONTROL SYSTEMS FOR AEROSPACE VEHICLES. Progress Report, April 1–April 30, 1962. (Northrop Corp. Northrop Space Labs., Hawthorne, Calif.). Contract AF33(657)-7851. 4p.

Study was continued on the determination of flight control system, definition of radiative environment, determination of radiation penetration through satellite walls, determination of radiation damage criteria, and determination of radiation effects of flight control systems. (auth)

36985 (AD-295102) DESIGN CRITERIA FOR RADIATION RESISTANT FLIGHT CONTROL SYSTEMS FOR AEROSPACE VEHICLES. Progress Report, June 1–June 30, 1962. (Northrop Corp. Northrop Space Labs., Hawthorne, Calif.). Contract AF33(657)-7851. 4p.

Study was continued on determination of radiation penetration through satellite walls, determination of radiation damage criteria, and determination of radiation effects on flight control systems. (auth)

36986 (AFSWC-TDR-62-119) STUDY OF BERYLLIUM BURNUP AND DISPERSION FOR RE-ENTERING NUCLEAR AUXILIARY POWER SYSTEMS. A. L. Feild, Jr. (Westinghouse Electric Corp. Astronuclear Lab., Pittsburgh). Dec. 1962. Contract AF29(601)-5078. 152p. (AD-294404)

Analytical studies were conducted to determine (1) orbital reentry burnup behavior of beryllium reflectors in SNAP reactor systems and (2) toxic hazard produced at ground level by ablated and dispersed beryllium residue from re-entering SNAP reflector. Digital computer programs were formulated to calculate trajectories, aerodynamic heating, oxidations, and mass loss rates of specific beryllium shapes re-entering under proposed flight program conditions. Concluding studies postulated actual reentry of a SNAP-10A reflector. Toxic hazards were determined by calculation of atmospheric dispersal and fallout of beryllium particles in the toxic size range. Studies concluded that varying degrees of reflector burnup will occur, depending upon reentry attitude and point of release from the reactor assembly. However, no toxic hazard will exist at ground level even with complete reflector burnup at lowest possible altitude. (auth)

36987 (SY-5394-R(Vol.I)) TECHNICAL PROPOSAL—ADVANCED CLOSED-BRAYTON-CYCLE SPACE POWER SYSTEM. (Garrett Corp. AiResearch Mfg. Div. of Arizona, Phoenix). Aug. 24, 1962. 482p.

The results of an extensive study of a Brayton cycle space power system using the SNAP-8 reactor as a heat source are reported. The system presented is a closed, recuperated, inert gas cycle, comprising a combined rotating power unit supported on gas bearings, a primary heat exchanger, a recuperator, a radiator, and a start and control system. (N.W.R.)

36988 (SY-5394-R(Vol.II)) TECHNICAL PROPOSAL—ADVANCED CLOSED-BRAYTON-CYCLE SPACE POWER SYSTEM. (Garrett Corp. AiResearch Mfg. Div. of Arizona, Phoenix). Aug. 24, 1962. 146p.

Development of the advanced closed-Brayton-cycle space power system is reported. Information is presented on the Garrett Corporation background and facilities, AiResearch Test Laboratories, optimization of recuperated Brayton cycle, selection of gas medium for Brayton cycle for space power plants, radiator heat transfer analysis, meteoroids and meteoroid protection, and effective sink temperature analysis. (N.W.R.)

36989 (UCRL-7374) NUCLEAR PROPULSION—BACKGROUND AND ENVIRONMENTAL CONDITIONS. A. J. Rothman (California. Univ., Livermore. Lawrence Radiation Lab.). May 1, 1963. Contract W-7405-eng-48. 51p. (CONF-173-1)

From Symposium on Ceramics in Aerospace Technology, Los Angeles, Jan. 1963.

A general review is presented of space propulsion projects with respect to materials requirements. The characteristics and requirements of Pluto (nuclear ramjet) are described. The general requirements for propulsion in space and the classes of nuclear rockets are outlined. Materials requirements and problems are discussed in detail for the heat transfer nuclear rocket (Rover). (D.L.C.)

36990 THE NUCLEAR ROCKET PROGRAM. W. S. Fellows, F. J. Magliato, and R. D. Hensley. 5p. (CONF-94-8)

From American Nuclear Society Meeting, Nuclear Materials for Space Applications, Cincinnati, Apr. 1963.

Project RIFT (Reactor-in-Flight-Test) is expected to furnish the vehicles for the first flight tests of nuclear-rocket engines and to demonstrate the practicality of nuclear-rocket propulsion for space vehicle application. The project consists of the design of the nuclear stage, the associated research and development necessary to qualify materials and components that will adequately withstand the environment of nuclear radiation, the fabrication and assembly of the stages for static testing and launching, integration of the NERVA Engine and other systems into a complete stage and the stage into a complete vehicle, and finally, static testing and flight demonstration. This program covers a span of six to seven years. (A.G.W.)

WASTE DISPOSAL AND PROCESSING

36991 (HW-75565) INVENTION REPORT — USE OF SUGAR TO NEUTRALIZE NITRIC ACID WASTE LIQUORS. L. A. Bray and E. C. Martin (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Nov. 11, 1962. Contract [AT(45-1)-1350]. 13p.

A process is described for the use of sugar in the destruction of nitric acid in waste solutions. The efficiency of the denitration is found to be a function of temperature and moles of dissolved metal cations. The sugar may be used either in batch of continuous processes, does not require addition of anti-foam agents, and was estimated to reduce the chemical costs of present denitration operations by 50%. (B.O.G.)

36992 (HW-SA-2881) THE HANFORD DECONTAMINATION FACILITY. L. R. Wallis (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). May 10, 1963. Contract AT(45-1)-1350. 20p. (CONF-67-19).

From Health Physics Society 8th Annual Meeting, New York, June 1963.

A high-level facility was constructed for large-scale decontamination of failed chemical process equipment. The jobs which were performed using the facility are described. A separate low-level facility for the decontamination of railroad equipment, automobiles, etc., is also described. A procedure for pre-burial decontamination is described in which the equipment is first treated to remove gross loose contamination and then sprayed with a plastic resin paint to fix any residual loose contamination; burial is then carried out with no container. (D.L.C.)

36993 (TID-19164) DEPARTMENT OF CHEMICAL ENGINEERING PROGRESS REPORT NO. 1, FEBRUARY 1, 1957–OCTOBER 31, 1958. PART I. ADSORPTION OF CALCIUM AND STRONTIUM ON HYDROUS FERRIC OXIDE AND LIMONITE. PART II. PERCOLATION STUDIES. A. A. Armstrong, Jr. and B. L. Baker (South Carolina. Univ., Columbia). Contract AT(38-1)-147. 69p.

A review of the literature was made on the adsorption of ions by the compounds of iron and related compounds. The investigation of the absorption of calcium on hydrous ferric oxide and limonite covered a range of solution pH from 6.0 to 10.0 and equilibrium calcium solution concentrations from 1.0×10^{-4} to 5.0×10^{-2} N. Calcium solution concentrations were determined by the EDTA titration method. The investigation of the adsorption of strontium on hydrous ferric oxide and limonite covered a range of solution pH from 6.0 to 12.0 and equilibrium strontium solution concentrations from 1.0×10^{-7} to 1.0×10^{-1} N. Strontium solution concentrations were determined by the radioactive tracer technique using Sr-89 tracer. There was no significant adsorption of either calcium or strontium on hydrous ferric oxide at pH 6.0. The fraction adsorbed increased with increase in pH (7.0 and above) and increased with decrease in equilibrium solution concentration. The distribution coefficients for calcium and strontium between the solid and liquid phases increased with increase in pH and increased with decrease in equilibrium solution concentration. The adsorption of calcium and strontium on limonite was on the order of one-tenth of the adsorption of hydrous ferric oxide. A study was made of the percolation rates of liquid through a few selected samples of soil taken from areas near the low level radioactive waste disposal basins of the Savannah River Plant. The study has indicated that seepage rates through soils described as sandy clay and clayey sand are fairly high for liquids with pH values below 6. When feed solutions were increased above pH 6 seepage rates decreased; at pH values of 10 and above seepage rates would even stop. Increased flow rates could not be restored with acid feed solutions. Acid feed solutions showed increased flow rates over initial rates and approached a constant flow. Sodium nitrate solutions of 1M have little effect on flow rates through clayey sand soils. (auth)

36994 (TID-19186) DEPARTMENT OF CHEMICAL ENGINEERING PROGRESS REPORT NO. 6, FEBRUARY 1, 1960–SEPTEMBER 1, 1960. PART II. SOIL PERCOLATION STUDIES. B. L. Baker (South Carolina. Univ., Columbia). Dec. 16, 1960. Contract AT(38-1)-147. 5p.

The seepage of liquids through soils is studied by correlating the effects of particle diameter of the soils on flow. Particle diameters are calculated to make the data fit the Carman and Kozeny equations as modified by Ergun for flow through porous media. If the effective diameters of the particles are known for the narrow ranges of sieve sizes, then it may be possible to predict the flow through soil mixtures of all particle sizes provided the effective diameters of all ranges of sieve sizes in the soil are known. The results of the work thus far indicate that this method of approach to the problem of predicting flow rates of liquids through soils looks very promising. It was found in the tests on the individual range of sieve sizes that there was little difference between the flow rates of neutral water and water with pH 3. This was also true of water of pH 10 through the range 40–45. With particles smaller than 40–45 mesh, flow of water at pH 10 continued to decrease indicating that complete plugging of the samples would eventually occur. (N.W.R.)

36995 (TID-19187) PART I. INORGANIC SORBENTS. B. L. Baker and T. H. Wilson. PART II. SOIL PERCOLATION STUDIES. E. R. Conway. Progress Report No. 8, February 1962 to May 1963. (South Carolina. Univ., Columbia). June 21, 1963. Contract AT(38-1)-147. 91p.

Column studies show that $Al_2O_3 \cdot 10SiO_2$ has an exchange capacity of about 1.6 meq. of Cs per gram of silicate. The cesium can be eluted with sodium chloride solutions and the column recycled. Elution can also be done with hydrochloric acid; however, the column must be regenerated with a solution of sodium ions before sorption of cesium will again take place. Heating of the aluminum silicates at 800 to 1200°F for 24 hr materially lowers sorption capacity for cesium. Method of preparation of hydrous ferric oxides for strontium sorption indicates best results are given by material precipitated from strong ferric chloride solutions added to intermediate strengths of base. The mechanism of sorption of strontium by hydrous ferric oxides appears to be $Sr^{++}-H^{+}$ exchange which may be explained by the double layer theory. Another possibility, that can not be ruled out, is $Sr(OH)^{+}-H^{+}$ exchange. A very small amount of $Sr^{++}-Na^{+}$ exchange takes place. The hydrous ferric oxide acts as variable capacity exchanger for strontium, strongly pH dependent with increased capacity at the higher pH values. Other metal silicates, prepared in the same manner as the aluminum silicates, show fair capacities for cesium sorption but are not as good as the aluminum silicates. A study

was undertaken to test the applicability of the Ergun equation to water flowing through packed beds of soil taken from the Savannah River Plant. Runs were made with blends of the various narrow soil cuts reconstituted so as to simulate the condition of the original soil. Runs were made with beds packed with vibration while air was being passed through them in the direction used by the water in the experimental work. The magnitude of the effects varied with the particle shape. Data were taken also for beds composed of spherical glass beds. Measurements of the various soil particles were made with a microscope. The design and operation of the permeameter is described. (N.W.R.)

36996 (TID-19188) DEPARTMENT OF CHEMICAL ENGINEERING PROGRESS REPORT NO. 4, OCTOBER 31, 1958–JANUARY 31, 1960. PART II. SOIL PERCOLATION STUDIES. B. L. Baker (South Carolina. Univ., Columbia). May 18, 1960. Contract AT(38-1)-147. 14p.

Seepage or percolation rates through soil samples from well drillings from the seepage basin areas in the Savannah River Plant were measured. Seepage solutions were demineralized water at pH 6 and water adjusted to pH 3 with nitric acid. Correlation of flow rates were attempted by a modification of the Poiseuille equation for laminar flow based on soil particle diameters and porosity. The correlation showed a definite pattern, but varied over the very wide limits of three orders of magnitude indicating that other effects need to be evaluated. (auth)

36997 (TID-19189) DEPARTMENT OF CHEMICAL ENGINEERING PROGRESS REPORT NO. 7, JANUARY 31, 1961–FEBRUARY 1, 1962. PART I. SORPTION STUDIES. B. L. Baker and T. H. Wilson. PART II. SOIL PERCOLATION STUDIES. E. R. Conway (South Carolina. Univ., Columbia). Apr. 17, 1962. Contract AT(38-1)-147. 58p.

The combination $Al_2O_3 \cdot 10SiO_2$ when precipitated, washed, and dried at 105°C gave maximum sorption of cesium when compared to other combinations. Sorption is greater from basic solutions than from acid solutions. The presence of excess amounts of sodium ion reduced sorption of cesium by $Al_2O_3 \cdot 10SiO_2$. pH changes have only a slight effect on cesium sorption by this compound. This compound has greater absorption for cesium than any of the magnesium silicates. From flame photometry measurements and hydrogen ion changes during sorption of cesium by $Al_2O_3 \cdot 10SiO_2$ it is believed that the sorption mechanism is cesium-sodium exchange. Hydrous iron oxides will sorb strontium only if they are in the wet state or dried at room temperatures. Aging of hydrous iron oxides has little effect (some slight increase may occur) on sorption of strontium. The Ergun equation for flow through a packed bed was tested for its applicability to flow of water through soil beds in flow equipment developed for this purpose. Samples of soil were screened into various narrow size cuts and values of the shape factor were found for each cut. The form of the Ergun equation was found to be applicable to flow through the soil cuts. Blends of several cuts of soil were also tested and the Ergun equation with the shape factor values already determined was found to predict accurately the flow characteristics for the mixtures. Spherical glass beads were also tested and the Ergun equation was found to fit a bed of such particles quite accurately. A microscopic study of the various soil cuts used showed shape factors 17% greater than those found from the Ergun equation. (N.W.R.)

36998 SIGNIFICANT RESULTS IN LOW-LEVEL WASTE TREATMENTS AT ORNL. K. E. Cowser and T. Tamura (Oak Ridge National Lab., Tenn.). Health Phys., 9: 687-96(July 1963).

Operating experience with the 500,000 gal/day waste treatment plant at Oak Ridge National Laboratory has demonstrated that plant efficiency exceeds the design specifications of 50% removal of gross radionuclides. An average of 85–90% of the Sr^{90} and Cs^{137} are removed. However, the full potential of the treatment plant can be realized only by modifying the process or by adding to the facility. A number of laboratory experiments were performed to investigate the effect of primary coagulants, of coagulant aids, and the use of natural minerals, on the removal of strontium and cesium. By optimizing the combination of lime, soda ash, and clay, removal of strontium and cesium was increased to 96 and 92%, respectively. Both supplemental phosphate addition to lime-soda softening and aluminum phosphate coagulation removed 98% of the strontium. Coagulant acids reduced the turbidity in treated waste and resulted in improved efficiency. Vermiculite (grade BO-4), one of the most promising of the minerals investigated, exhibited distribution coefficients for strontium and cesium in excess of 5000 for a solution typical of the effluent from the waste treatment plant. Process changes and possible addition to the plant were evaluated by direct application to the operating plant or by pilot-scale tests. (auth)

36999 REACTIONS AFFECTING STRONTIUM REMOVAL FROM RADIOACTIVE WASTES. Tsuneo Tamura and E. G. Struxness (Oak Ridge National Lab., Tenn.). Health Phys., 9: 697-704(July 1963).

Alumina powder with an exchange capacity of about 1 meq/100 g removed as much strontium as a montmorillonite sample with 91 meq/100 g capacity when tested in a simulated waste solution of 0.1M $NaNO_3$ containing 1.1×10^{-5}M $Sr(NO_3)_2$ and in a basic pH. Additions of orthophosphate to the simulated waste solution resulted in improved strontium removal by $CaCO_3$ powder. With 5000 ppm of orthophosphate, 0.5 g of $CaCO_3$ removed over 99% of the strontium from 50 cm^3 of simulated waste adjusted to pH 9. Under the same test conditions, natural vermiculite showed improvement, but sodium-saturated vermiculite showed a reduction in strontium removal. By pretreating vermiculite with solutions of NaCl and NaCl–NaOH, the mineral's affinity for strontium was improved, and an increase from 35 to 85% removal was obtained using a 0.5 g sorbent/50 ml solution ratio. From the slurry tests four possible mechanisms for removing strontium from radioactive wastes are suggested. These are: ion exchange as an absorption process exemplified by vermiculite, clinoptilolite, and the clay minerals; ion exchange as an adsorption process characterized by alumina and possibly variscite; metasomatic replacement as characterized by the $CaCO_3$-phosphate waste reaction; and precipitation reactions as evidenced by natural vermiculite in contact with phosphated waste. (auth)

37000 PREDICTION OF MOVEMENT OF RADIONUCLIDES IN SOLUTION THROUGH POROUS MEDIA. Yoriteru Inoue and Warren J. Kaufman (Univ. of California, Berkeley). Health Phys., 9: 705-15(July 1963).

The transport of a cationic radionuclide through the earth was determined by hydrodynamic convection, hydraulic dispersion, and ion-exchange sorption. If the manner of water movement is first ascertained by tritiated water tracer measurements and the exchange properties are determined by laboratory tests, it is possible to predict the arrival of individual radioisotopes at some distant point of concern. For the prediction theory to be fully applicable, the formation should be reasonably homogeneous,

the isotope distribution factor should remain constant, and exchange equilibria should prevail at all points. It is also desirable that the hydraulic flow net remain unchanged. The validity of the prediction theory was tested with laboratory columns and with a field investigation. The field test involved several arrays of injections and relief wells and twenty-three observation wells penetrating a confined aquifer 100 ft below the earth's surface. The results demonstrated the theoretical validity and practical utility of the theory. (auth)

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ø		oe
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As an aid to the users of this index, references to report numbers, where appropriate, are included after the abstract number of the citation.

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29	17-36959	ORINS
CONF-10–	**(Electric Propulsion Conference, Colorado Springs, Colo., March 1963)**	
30	17-36134	ORINS. New York American Institute of Aeronautics and Astronautics, 1963, Preprint 63018
45	17-35270	ORINS. New York, American Institute of Aeronautics and Astronautics, 1963, Preprint 63016
46	17-35969	ORINS. New York, American Institute of Aeronautics and Astronautics, 1963, Preprint 63025-63
49	17-36540	ORINS. New York, American Institute of Aeronautics and Astronautics, 1963, Preprint 63021
50	17-36829	ORINS. New York, American Institute of Aeronautics and Astronautics, 1963, Preprint 63003-63
54	17-36541	ORINS. New York, American Institute of Aeronautics and Astronautics, 1963, Preprint 63046
CONF-11–	**(American Nuclear Society Meeting, Washington, D. C., November 1963)**	
8	17-36340	Dep.(mc); $4.60(fs), $1.43(mf) OTS; Gmelin, AED-CONF-62-232-125
9	17-36369	ORINS. Gmelin, AED-CONF-62-232-128
CONF-14–	**(American Chemical Society 144th National Meeting, Los Angeles, Calif., March–April 1963)**	
19	17-35851	$2.60(fs), $0.92(mf) OTS; Gmelin, AED-CONF-63-025-24
28	17-35634	See TID-19094
33	17-35616	See HW-SA-2804
34	17-35689	See LADC-5709
35	17-35847	ORINS. Gmelin, AED-CONF-63-025-50
36	17-35930	ORINS. Gmelin, AED-CONF-63-025-45
37	17-36559	ORINS. Gmelin, AED-CONF-63-025-51
CONF-15–	**(American Power Conference, Chicago, March 1963)**	
4	17-36952	ORINS. Gmelin, AED-CONF-1963-023-5)
6	17-35271	ORINS. Gmelin, AED-CONF-1963-023-7
7	17-36953	ORINS. Gmelin, AED-CONF-1963-023-1
CONF-19–	**(2nd. International Congress of Radiation Research, Harrogate, Eng., August 1962)**	
1	17-35849	ORINS. Gmelin, AED-CONF-62-217-178
CONF-21–	**(National Association of Corrosion Engineers Meeting, New York, March 1963)**	
3	17-36225	See HW-76562(Rev.)
CONF-24–	**(Symposium on Engineering Aspects of Magnetohydrodynamics, Berkeley, Calif., April 1963)**	
8	17-36827	ORINS. Gmelin, AED-CONF-63-030-7
9	17-36334	ORINS. Gmelin, AED-CONF-63-030-6
17	17-35964	See UCRL-7191
CONF-28–	**(Second International Congress on Metallic Corrosion, New York, New York, March 1963)**	
4	17-36206	See UCRL-10712
CONF-29–	**(Conference on Modification of Radiation Injury by Bone Marrow Transplantation and Chemical Protection, New York, December 1962)**	
2	17-35615	ORINS
CONF-32–	**(Health Physics Society Meeting, Chicago, June 1962)**	
2	17-36026	Dep.(mc); $3.60(fs), $1.34(mf) OTS; Gmelin, AED-CONF-62-102-78
CONF-35–	**(American Physical Society, Cambridge, Mass., March 1963)**	
3	17-36102	ORINS. Gmelin, AED-CONF-63-024-4
CONF-39–	**(American Nuclear Society Meeting, Salt Lake City, Utah, June 1963)**	
22	17-36897	ORINS. Gmelin, AED-CONF-63-060-16
32	17-36898	ORINS. Gmelin, AED-CONF-63-060-23
86	17-36341	Dep.(mc); $1.10(fs), $0.80(mf) OTS; Gmelin, AED-CONF-63-060-91
87	17-35677	$1.10(fs), $0.80(mf) OTS; Gmelin, AED-CONF-63-060-95
88	17-36291	Dep.(mc); $1.10(fs), $0.80(mf) OTS; Gmelin, AED-CONF-63-060-96
89	17-36342	Dep.(mc); $1.10(fs), $0.80(mf) OTS; Gmelin, AED-CONF-63-060-97
90	17-36090	ORINS. Gmelin, AED-CONF-63-060-94
91	17-35996	ORINS. Gmelin, AED-CONF-63-060-98
CONF-46–	**(American Physical Society Meeting, Washington, D. C., April 1963)**	
9	17-36715	ORINS. Gmelin, AED-CONF-63-048-33
10	17-36543	ORINS. Gmelin, AED-CONF-63-048-32
11	17-36542	ORINS. Gmelin, AED-CONF-63-048-31
13	17-36717	ORINS. Gmelin, AED-CONF-63-048-27

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15	17-36713	ORINS. Gmelin, AED-CONF-63-048-21 Progr. Theoret. Phys. (Kyoto), 29: 938-40(1963)
16	17-36714	ORINS. Gmelin, AED-CONF-63-048-20
17	17-36176	ORINS. Gmelin, AED-CONF-63-048-19
18	17-36624	ORINS. Gmelin, AED-CONF-63-048-18
25	17-36716	ORINS. Gmelin, AED-CONF-63-048-70
93	17-36648	Dep.(mc); $3.60(fs), $1.37(mf) OTS; Gmelin, AED-CONF-63-048-106
94	17-36712	ORINS. Gmelin, AED-CONF-63-048-107
96	17-36539	ORINS. Gmelin, AED-CONF-63-048-108
CONF-50–	**(American Ceramic Society Annual Meeting, Pittsburgh, April–May 1963)**	
17	17-35848	ORINS. Gmelin, AED-CONF-63-046-17
CONF-51–	**(American Public Power Assn. 20th Annual Convention, Cleveland, April–May 1963)**	
2	17-36951	ORINS. Gmelin, AED-CONF-63-047-4
3	17-36950	ORINS. Gmelin, AED-CONF-63-047-3
CONF-52–	**(2nd International Conference on Nuclidic Masses, Vienna, July 1963)**	
4	17-36639	See BNL-7160
CONF-53–	**(1962 World Metal Show, New York, New York, Oct. 29–Nov. 2, 1962)**	
6	17-36270	ORINS
7	17-36272	ORINS
8	17-36243	Dep.(mc); $2.60(fs), $0.92(mf) OTS
CONF-57–	**(Electron Beam Symposium, Boston, March 1963)**	
3	17-36271	ORINS. Gmelin, AED-CONF-63-031-6
CONF-59–	**(ASM Western Metal Congress, Los Angeles, March 1963)**	
2	17-36536	ORINS. Gmelin, AED-CONF-63-037-6
3	17-36333	ORINS. Gmelin, AED-Conf-63-037-5
CONF-62–	**(3rd Conference on Reactions Between Complex Nuclei, Asilomar, Calif., April 1963)**	
12	17-36649	Dep.(mc); $1.60(fs), $0.80(mf) OTS; Gmelin, AED-CONF-63-054-14
13	17-36650	Dep.(mc); $1.60(fs), $0.80(mf) OTS; Gmelin, AED-CONF-63-054-13
CONF-65–	**(Federation of American Societies for Experimental Biology 47th Annual Meeting, Atlantic City, April 1963)**	
7	17-35435	ORINS. Gmelin, AED-CONF-63-052-12
CONF-66–	**(Symposium on the Biology of Radioiodine, Richland, Wash., June 1963)**	
7	17-35592	ORINS. Gmelin, AED-CONF-63-063-8
8	17-35405	See LADC-5794
CONF-67–	**(Health Physics Society Annual Meeting, New York, New York, June 1963)**	
19	17-36992	See HW-SA-2881
CONF-68–	**(Electrochemical Society, Pittsburgh, April 1963)**	
2	17-36535	ORINS. Gmelin, AED-CONF-63-064-4
CONF-72–	**(Transplutonium Element Symposium, Argonne, Ill., May 1963)**	
4	17-35678	Dep.(mc); $1.60(fs), $0.80(mf) OTS; Gmelin, AED-CONF-63-062-4
CONF-73–	**(Sixth Biennial Conference on Carbon, Univ. of Pittsburgh, June 1963)**	
13	17-36346	See HW-SA-2925(Rev.)
CONF-74–	**(ASTM Conference on Mass Spectrometry and Allied Topics, San Francisco, May 1963)**	
16	17-35668	ORINS. Gmelin, AED-CONF-63-050-29
17	17-36175	ORINS. Gmelin, AED-CONF-63-050-27
18	17-36538	ORINS. Gmelin, AED-CONF-63-050-25
19	17-36133	ORINS. Gmelin, AED-CONF-63-050-35
CONF-75–	**(Sixth International Symposium on Ionization Phenomena in Gases, Orsay, France, July 1963)**	
1	17-36747	$1.60(fs), $0.80(mf) OTS
5	17-36386	See LADC-5797
6	17-36749	See LADC-5798
CONF-78–	**(American Physical Society Meeting, Buffalo, June 1963)**	
2	17-36828	ORINS. Gmelin, AED-CONF-63-090-2
11	17-36623	ORINS. Gmelin, AED-CONF-63-090-18
CONF-83–	**(International URSI Conference, Tokyo, September 1963)**	
1	17-36565	ORINS
CONF-85–	**(American Meteorological Society Meeting, Washington, D. C., April 1963)**	
1	17-36017	ORINS. Gmelin, AED-CONF-63-072-2
CONF-89–	**(International Symposium on Humidity and Moisture, Washington, D. C., May 1963)**	
1	17-35401	ORINS. Gmelin, AED-CONF-63-068-5
3	17-35403	ORINS. Gmelin, AED-CONF-63-068-3
4	17-35400	ORINS. Gmelin, AED-CONF-63-068-1
8	17-35402	ORINS
CONF-91–	**(6th National Instrumentation Symposium, Philadelphia, May 1963)**	
1	17-36955	ORINS. Gmelin, AED-CONF-63-088-1
CONF-93–	**(International Coaxial Plasma Gun Symposium, Cleveland, September 1962)**	
1	17-36826	ORINS
CONF-94–	**(American Nuclear Society Meeting, Nuclear Materials for Space Applications, Cincinnati, April 1963)**	
8	17-36990	ORINS. Gmelin, AED-CONF-63-067-6
CONF-97–	**(Summer Meeting, Los Angeles, June 1963)**	
9	17-36825	ORINS. New York, American Inst. of Aeronautics and Astronautics, 1963, Preprint 63-281, $1.00
11	17-36533	ORINS. New York, American Inst. of Aeronautics and Astronautics, 1963, Preprint 63-159, $1.00
13	17-36824	ORINS. New York, American Inst. of Aeronautics and Astronautics, 1963, Preprint 63-163, $1.00
16	17-36532	ORINS. New York, American Inst. of Aeronautics and Astronautics, 1963, Preprint 63-156, $1.00
19	17-36534	ORINS. New York, American Inst. of Aeronautics and Astronautics, 1963, Preprint 63-216, $1.00
CONF-114–	**(International Conference on High Energy Accelerators, Dubna, August 1963)**	
6	17-36719	Dep.(mc); $1.60(fs), $0.80(mf) OTS
7	17-36720	Dep.(mc); $3.60(fs), $1.25(mf) OTS
8	17-36721	Dep.(mc); $4.60(fs), $1.61(mf) OTS
CONF-122–	**(International Conference on Nucleon Structure, Stanford Univ., June 1963)**	
8	17-36569	Dep.(mc); $1.10(fs), $0.80(mf) OTS; Gmelin, AED-CONF-63-101-3
9	17-36570	Dep.(mc); $1.10(fs), $0.80(mf) OTS; Gmelin, AED-CONF-63-101-7

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CONF-124–	**(Symposium on the Application of Advanced Technology to Coal Research, Lexington, Ky., June 1963)**	
3	17-36101	ORINS. Gmelin, AED-CONF-63-092-3
CONF-126–	**(Conference on Noble Gas Compounds, Argonne, Ill., April 1963)**	
6	17-35676	See BNL-6828
11	17-35679	Dep.(mc); $1.60(fs), $0.80(mf) OTS; Gmelin, AED-CONF-63-085-7
12	17-36537	ORINS. Gmelin, AED-CONF-63-085-12
15	17-35708	See UCRL-10803
16	17-35709	See UCRL-10804
17	17-35707	See UCRL-7343-T
18	17-35680	Dep.(mc); $1.60(fs), $0.80(mf) OTS; Gmelin, AED-CONF-63-085-18
CONF-141–	**(Congress of the Associazione Italiana di Fisica Sanitaria, Turin, February 1963)**	
1	17-36087	ORINS
CONF-142–	**(25th National Congress on Labor Medicine, Taormina, Italy, October 1962)**	
1	17-36088	ORINS
2	17-36089	ORINS
CONF-143–	**(Congress of the European Atomic Energy Society on the Fundamental Problems of Nuclear Power Plants Likely to be Built in the Next Ten Years, Cannes, France, October 1962)**	
1	17-36954	ORINS
CONF-144–	**(Giornate dell' Energia Nucleare Proceedings, Milan, December 1962)**	
1	17-36835	ORINS
CONF-147–	**(Instrument Society of America Conference, Chicago, September 1963)**	
1	17-36124	See UCRL-7276
CONF-149–	**(Conference on Leukopoiesis in Health and Disease, New York, May 1963)**	
1	17-35275	See BNL-7143
CONF-164–	**(Society of Nuclear Medicine 10th Annual Meeting, Montreal, June 1963)**	
1	17-35593	ORINS. Gmelin, AED-CONF-63-100-1
2	17-35274	See BNL-6824
4	17-35594	ORINS. Gmelin, AED-CONF-63-100-6
CONF-167–	**(Journees Metallurgiques d'Automne, Paris, October 1962)**	
1	17-36295	See EUR-378.f
CONF-170–	**(Conference on the Physical Metallurgy of Beryllium, Gatlinburg, Tenn., April–May 1963)**	
1	17-36299	See NMI-TJ-54
CONF-171–	**(Symposium on Chemistry of Irradiated Fuel Treatment by Aqueous Process, Brussels, April 1963)**	
1	17-36246	See EURAEC-635
CONF-173–	**(Symposium on Ceramics in Aerospace Technology, Los Angeles, January 1963)**	
1	17-36989	See UCRL-7374
CONF-176–	**(Cryogenic Engineering Conference, Boulder, Colo., August 1963)**	
2	17-36375	Dep.(mc); $1.60(fs), $0.80(mf) OTS; Gmelin, AED-CONF-63-124-1
3	17-36027	See LADC-5863
CONF-177–	**(National Space Electronics Symposium, Miami Beach, Fla., October 1963)**	
1	17-36120	See SCDC-3135
CONF-178–	**(European Atomic Energy Society's Symposium on Fuel Cycles for Power Reactors, Baden-Baden, Germany, September 1963)**	
1	17-36876	See ORNL-TM-678
CONF-180–	**(Symposium on Thermodynamics and Thermochemistry, Lund, Sweden, July 1963)**	
1	17-35691	See LADC-5871
CONF-181–	**(Utilization of Multiparameter Analyzer Meeting, Grossingers, N. Y., November 1962)**	
1	17-36112	See BNL-6518
2	17-36123	See TID-17866
CONF-182–	**(9th Scintillation and Semiconductor Counter Symposium, Washington, D. C., February 1963)**	
1	17-36151	See LADC-5906
CONF-183–	**(Hot Laboratory Conference, Argonne, Ill., May 1963)**	
1	17-35692	See LADC-5913
CONF-184–	**(Symposium on Inorganic Fluorine Chemistry, Argonne, Ill., September 1963)**	
1	17-35690	See LADC-5861
CONF-185–	**(Institute of Environmental Sciences Meeting, Los Angeles, April 1963)**	
1	17-36350	See SCR-688
CONF-186–	**(3rd International Conference on the Physics of Electronic and Atomic Collisions, London, July 1963)**	
1	17-36376	Dep.(mc); $2.60(fs), $0.86(mf) OTS
CONF-187–	**(American Nuclear Society Meeting, New York, November 1963)**	
1	17-35936	Dep.(mc); $1.60(fs), $0.80(mf) OTS
2	17-36874	See LADC-5799
3	17-35956	See LADC-5761
4	17-35957	See LADC-5772
5	17-36873	See LADC-5783
6	17-35998	See LADC-5760
8	17-36872	See LADC-5773
CONF-188–	**(Proceedings of the 1st Inter-American Conference on Radiochemistry, Montevideo, July 1963)**	
1	17-35867	See BNL-7135
CONF-189–	**(Proceedings of the 11th Annual Conference on Mass Spectrometry, San Francisco, May 1963)**	
1	17-36119	See SCDC-3041
CRCE–	**(Canadian)**	
1096	17-36863	Dep.; $2.00(AECL)
CRRIS–	**(Canadian)**	
1150	17-36147	Dep.; $0.50(AECL)
CRRP–	**(Canadian)**	
1151	17-36864	Dep.; $1.50(AECL)
1159	17-36627	Dep.; $2.00(AECL)
CU(PNPL)–		
227(p.29-34)	17-36112	See BNL-6518
227(p.104-11)	17-36123	See TID-17866
D–	**(Misc.)**	
1-82-0192*	17-36748	$5.60(OTS)

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DASA–	**(Misc.)**	
1285(Pt.V)*	17-35954	$8.10(OTS)
1303*	17-36006	$6.60(OTS)
1304*	17-36007	$6.60(OTS)
DESY-A–	**(German)**	
2.101	17-36722	Dep.(mc)
DLCS–		
5000763	17-36925	Dep.(mc); $5.60(fs), $1.85(mf) OTS
DPST–		
63-69-8	17-35985	Dep.(mc); $1.10(fs), $0.80(mf) OTS
63-71-2	17-36223	Dep.(mc); $1.60(fs), $0.80(mf) OTS
63-74-7	17-36292	Dep.(mc); $1.10(fs), $0.80(mf) OTS
DRCL–	**(Canadian)**	
416	17-35875	Can. J. Chem., 41: 2372-9(1963)
DRI–	**(Misc.)**	
2079*	17-36293	$4.60(OTS)
DUBNA REPORTS	**(Russian)**	
See JINR (Russian)		
EDR–	**(Non-AEC)**	
3390	17-36372	See AD-410495
EFINS–	**(Misc.)**	
62-61	17-36571	Dep.(mc); $5.60(fs), $2.00(mf) OTS
62-71	17-36651	Dep.(mc); $5.60(fs), $1.76(mf) OTS
EGG-B–	**(Non-AEC)**	
2462	17-36343	
2516	17-36008	$8.60(OTS)
EIR–	**(Swiss)**	
50	17-35868	Dep.(mc)
55	17-36652	Dep.(mc)
EOS–	**(Non-AEC)**	
3410-Q-3	17-36300	See NP-13070
EUR–	**(European Atomic Energy Community)**	
101.e	17-36954	See CONF-143-1
119.e	17-36653	Dep.(mc)
168.f	17-36076	Rev. Belge Securite Sociale, 1-41(1963)
172.f	17-36048	Diritto Econ. Nucl., No. 1, 23-31(1962)
233.i	17-36835	See CONF-144-1
242.e	17-35615	See CONF-29-2
304.e	17-36865	Dep.(mc)
333.i	17-36088	See CONF-142-1
334.i	17-36089	See CONF-142-2
337.e	17-36294	Dep.(mc)
364.i	17-36087	See CONF-141-1
366.e	17-35681	Dep.(mc)
378.f	17-36295	Dep.(mc)
EURAEC–		
210	17-36244	Dep.(mc); $2.60(fs), $0.83(mf) OTS
411	17-36245	Dep.(mc); $6.60(fs), $2.15(mf) OTS
635	17-36246	Dep.(mc); $2.60(fs), $0.98(mf) OTS
744	17-36221	See BMI-1636
764	17-36155	See WCAP-2346
800	17-36869	See GNEC-287
FN-E–	**(Italian)**	
24	17-36245	See EURAEC-411
FTD-MT–	**(Non-AEC)**	
62-78	17-35276	OTS

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FZK–	**(Non-AEC)**	
153	17-36859	See AFSWC-TDR-62-54
9-184	17-36347	See NARF-62-18P
GA–	**(Misc.)**	
3616*	17-36344	$4.60(OTS)
3798*	17-36377	$2.60(OTS)
GA-Phys.–	**(Non-AEC)**	
62-7	17-36106	See AD-286924
62-9	17-36335	See AD-287146
62-13	17-36107	See AD-286925
GAMD–	**(Misc.)**	
2873	17-36866	Dep.(mc); $3.60(fs), $1.13(mf) OTS
3977(Rev.1)	17-36926	Dep.(mc); $9.10(fs), $3.41(mf) OTS
GEAP–	**(Misc.)**	
3771-9	17-36193	Dep.(mc); $8.10(fs), $2.75(mf) OTS
4075	17-36927	Dep.; $3.00(OTS)
4126	17-36928	Dep.; $3.00(OTS)
4229	17-36867	Dep.; $0.50(OTS)
4243	17-36929	Dep.(mc); $12.00(fs), $5.03(mf) OTS
4312	17-36247	Dep.(mc); $5.60(fs), $1.91(mf) OTS
GEMP–		
25A	17-36194	Dep.; $1.00(OTS)
26A	17-36345	Dep.; $0.75(OTS)
78	17-36868	Dep.; $1.00(OTS)
218	17-36224	Dep.(mc); $2.60(fs), $0.83(mf) OTS
GNEC–		
287	17-36869	Dep.(mc); $7.60(fs), $2.54(mf) OTS
HW–		
70951	17-36148	$1.60(fs), $0.80(mf) OTS
71113	17-36833	Dep.(mc); $2.60(fs), $1.04(mf) OTS
75292	17-36113	Dep.(mc); $1.60(fs), $0.80(mf) OTS
75299	17-35955	Dep.(mc); $1.10(fs), $0.80(mf) OTS
75565	17-36991	Dep.(mc); $1.60(fs), $0.80(mf) OTS
76000	17-35287	Dep.; $3.50(OTS)
76301	17-36195	Dep.; $2.50(OTS)
76301(Paper 1)	17-36196	
76301(Paper 2)	17-36197	
76301(Paper 3)	17-36198	
76549	17-36962	Dep.(mc); $1.10(fs), $0.80(mf) OTS
76562(Rev.)	17-36225	Dep.; $0.50(OTS)
77681	17-35986	Dep.; $0.75(OTS)
78193	17-36149	Dep.; $0.50(OTS)
78260 CH	17-36296	Dep.(mc); $1.10(fs), $0.80(mf) OTS
HW-SA–		
2804	17-35616	Dep.(mc); $2.60(fs), $0.92(mf) OTS
2830	17-35682	Dep.(mc); $1.10(fs), $0.80(mf) OTS Spectrochim. Acta, 19: 1619-21(1963)
2837	17-35683	Dep.(mc); $2.60(fs), $0.89(mf) OTS
2840	17-36654	Dep.(mc); $2.60(fs), $0.83(mf) OTS Nucl. Sci. Eng., 17: 144-8(1963)
2841	17-35252	Dep.(mc); $1.60(fs), $0.80(mf) OTS
2852	17-36226	Dep.(mc); $3.60(fs), $1.19(mf) OTS
2881	17-36992	Dep.(mc); $1.60(fs), $0.80(mf) OTS
2925(Rev.)	17-36346	Dep.(mc); $1.60(fs), $0.80(mf) OTS; Gmelin, AED-CONF-63-061-17
2974	17-35316	See HW-76000
IA–	**(Non-AEC)**	
775	17-35253	Dep.(mc)
809	17-35684	Dep.(mc)
IDO–		
16870	17-36199	Dep.; $1.00(OTS)

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16889	17-36114	Dep.; $2.00(OTS)
16894	17-36969	Dep.; $1.75(OTS)
16898	17-35254	Dep.; $1.25(OTS)
16899	17-36970	Dep.; $0.50(OTS)
IITRI–	**(Misc.)**	
1184-10	17-36378	Dep.(mc); $4.60(fs), $1.46(mf) OTS
A6034-1	17-36655	Dep.(mc); $1.60(fs), $0.80(mf) OTS
B6001-5*	17-35997	
IS–		
284	17-35937	Dep.(mc); $1.60(fs), $0.80(mf) OTS
560	17-35685	Dep.(mc); $1.10(fs), $0.80(mf) OTS
589	17-35686	Dep.(mc); $1.10(fs), $0.80(mf) OTS
594	17-36297	Dep.(mc); $1.60(fs), $0.80(mf) OTS
596	17-35687	Dep.(mc); $1.60(fs), $0.80(mf) OTS
606	17-36150	Dep.(mc); $1.10(fs), $0.80(mf) OTS
612	17-35628	Dep.(mc); $2.60(fs), $0.89(mf) OTS Anal. Chim. Acta, 29: 240-8(1963)
657	17-35852	Dep.; $0.50(OTS)
ISS–	**(Italian)**	
63/29	17-36379	Dep.(mc)
63/30	17-36382	Dep.(mc)
JAERI-Memo–	**(Japanese)**	
1122	17-36971	Dep.(mc)
JINR–	**(Russian)**	
D-1324	17-36656	Dep.(mc) Phys. Letters, 6: 100-2(1963) (In English)
D-1329	17-36572	Dep.(mc)
E-1271	17-36573	Dep.(mc)
E-1298	17-36574	Dep.(mc)
E-1314	17-36385	Dep.(mc) Phys. Letters, 6: 59-62(1963) (In English)
E-1339	17-36575	Dep.(mc)
P-1295	17-36576	Dep.(mc)
P-1300	17-36577	Dep.(mc)
P-1347	17-36657	Dep.(mc)
JPRS–	**(Non-AEC)**	
20520	17-35343	$0.50(OTS)
20630	17-35346	$1.00(OTS)
20713	17-35602	$0.50(OTS)
20735	17-35459	$0.50(OTS)
20805	17-36093	$0.50(OTS)
20864	17-35438	$0.50(OTS)
KR–	**(Norwegian)**	
47	17-36871	Dep.(mc)
LA–		
2921	17-35629	Dep.; $0.50(OTS)
LADC–		
5549	17-35597	Dep.(mc); $1.10(fs), $0.80(mf) OTS
5555	17-35688	$2.60(fs), $0.95(mf) OTS
5581	17-36185	Dep.(mc); $1.10(fs), $0.80(mf) OTS
5685	17-35735	J. Chem. Phys., 39: 1172-6(1963)
5686	17-35736	J. Chem. Phys., 39: 1176-81(1963)
5709	17-35689	Dep.(mc); $1.10(fs), $0.80(mf) OTS
5760	17-35998	Dep.(mc); $1.10(fs), $0.80(mf) OTS
5761	17-35956	Dep.(mc); $1.60(fs), $0.80(mf) OTS
5772	17-35957	Dep.(mc); $1.10(fs), $0.80(mf) OTS
5773	17-36872	Dep.(mc); $1.60(fs), $0.80(mf) OTS
5783	17-36873	Dep.(mc); $5.60(fs), $1.97(mf) OTS
5794	17-35405	Dep.(mc); $3.60(fs), $1.31(mf) OTS
5797	17-36386	Dep.(mc); $2.60(fs), $1.10(mf) OTS
5798	17-36749	Dep.(mc); $1.60(fs), $0.80(mf) OTS
5799	17-36874	Dep.(mc); $1.60(fs), $0.80(mf) OTS
5818	17-35751	J. Chem. Phys., 39: 1550-1(1963)
5861	17-35690	Dep.(mc); $1.60(fs), $0.80(mf) OTS
5863	17-36027	Dep.(mc); $1.10(fs), $0.80(mf) OTS
5871	17-35691	Dep.(mc); $2.60(fs), $1.04(mf) OTS
5906	17-36151	Dep.(mc); $1.60(fs), $0.80(mf) OTS
5913	17-35692	Dep.(mc); $1.60(fs), $0.80(mf) OTS
5951	17-36658	Dep.(mc); $1.10(fs), $0.80(mf) OTS
5952	17-36659	Dep.(mc); $1.10(fs), $0.80(mf) OTS
5953	17-36152	Dep.(mc); $1.10(fs), $0.80(mf) OTS
5954	17-36153	Dep.(mc); $1.60(fs), $0.80(mf) OTS
LAMS–		
2934	17-35987	Dep.; $1.25(OTS)
LAS-TR–	**(Misc.)**	
161-58	17-36121	See TID-14178(Suppl.1)
LF–		
7	17-36115	Dep.; $0.50(OTS)
LRP–	**(Swiss)**	
3-63	17-36750	Dep.(mc)
MATT–		
90	17-36387	$8.60(fs), $2.99(mf) OTS
139	17-36751	Dep.(mc); $4.60(fs), $1.46(mf) OTS
153	17-36752	Dep.(mc); $3.60(fs), $1.40(mf) OTS Phys. Fluids, 6: 1492-9(1963)
MITS–		
50	17-35617	See NYO-10329
NAA-SR–		
7909	17-35988	Dep.; $1.75(OTS)
NAA-SR-Memo–		
7470	17-35958	Dep.(mc); $2.60(fs), $0.86(mf) OTS
7748	17-36248	Dep.(mc); $2.60(fs), $0.92(mf) OTS
7769	17-35999	Dep.(mc); $1.10(fs), $0.80(mf) OTS
8060(Rev.)	17-36298	Dep.(mc); $1.10(fs), $0.80(mf) OTS
8161	17-36249	Dep.(mc); $1.60(fs), $0.80(mf) OTS
8202	17-36250	Dep.(mc); $2.60(fs), $0.89(mf) OTS
8690	17-36660	Dep.(mc); $2.60(fs), $1.10(mf) OTS
NARF–	**(Non-AEC)**	
62-18P	17-36347	$21.00(OTS)
NASA-TN–	**(Misc.)**	
D-1739*	17-36227	$1.25(OTS)
NASA-TR–	**(Non-AEC)**	
R-169	17-36548	
NBL–		
195	17-35630	Dep.; $1.25(OTS)
NLCO–		
885	17-35931	Dep.; $1.25(OTS)
NMI–	**(Misc.)**	
4971	17-36251	Dep.(mc); $11.50(fs), $4.88(mf) OTS
NMI-TJ–		
54	17-36299	Dep.(mc); $3.60(fs), $1.16(mf) OTS
NOL-TR–	**(Non-AEC)**	
62-191	17-35255	$2.60(OTS)
NP–	**(AEC File No. for Non-AEC Reports)**	
12622(Pt.5)	17-36549	
12983	17-35693	Dep.(mc)

Report No.	Abstract No.	Availability
13020	17-36388	
13033	17-36200	
13035	17-36028	Dep.(mc); $0.25(BIS), 1s. 9d. (HMSO)
13043	17-36201	$8.10(OTS) as AD-417185
13055	17-35598	Dep.(mc); $1.60(fs), $0.80(mf) OTS
13060	17-35331	
13061	17-36440	
13070	17-36300	
13071	17-36441	
13084	17-36442	$7.60(OTS) as AD-418059
13085	17-35256	Dep.(mc)
13089	17-36443	
13090	17-36444	
NRC–	**(Canadian)**	
7471	17-35854	Can. J. Chem., 41: 2389-90(1963)
NSEC–		
79(Pt.I)	17-36029	Dep.(mc); $2.60(fs), $0.83(mf) OTS
79(Pt.II)	17-36030	Dep.(mc); $1.60(fs), $0.80(mf) OTS
84	17-36031	Dep.(mc); $2.60(fs), $1.10(mf) OTS
NUMEC-P–		
8	17-36252	Dep.(mc); $1.10(fs), $0.80(mf) OTS
59	17-36253	Dep.(mc); $1.10(fs), $0.80(mf) OTS
NYO–		
2998	17-36339	See CEND-158
4691	17-35694	Dep.(mc); $3.60(fs), $1.28(mf) OTS
9800	17-35959	Dep.(mc); $6.60(fs), $2.27(mf) OTS
10106	17-36445	Dep.(mc); $1.10(fs), $0.80(mf) OTS J. Appl. Phys., 34: 1973-5(1963)
10150	17-35960	Dep.(mc); $1.60(fs), $0.80(mf) OTS
10329	17-35617	Dep.; $1.25(OTS)
10593	17-36348	Dep.(mc); $3.60(fs), $1.25(mf) OTS
ORNL–		
3393	17-36972	Dep.; $1.25(OTS)
3411	17-35695	Dep.; $6.60(fs), $2.15(mf) OTS
3424	17-36228	Dep.; $1.25(OTS)
3486	17-36117	Dep.; $9.60(fs), $3.98(mf) OTS
ORNL-TM–		
455	17-36301	Dep.(mc); $2.60(fs), $0.89(mf) OTS
462	17-35696	Dep.(mc); $1.60(fs), $0.80(mf) OTS
545	17-35618	Dep.(mc); $8.10(fs), $2.66(mf) OTS
597	17-36009	Dep.(mc); $1.60(fs), $0.80(mf) OTS
611	17-36875	Dep.(mc); $1.60(fs), $0.80(mf) OTS
628	17-35257	Dep.(mc); $3.60(fs), $1.25(mf) OTS
629	17-36000	Dep.(mc); $3.60(fs), $1.19(mf) OTS
634	17-35938	Dep.(mc); $7.60(fs), $2.48(mf) OTS
646	17-36628	Dep.(mc); $1.10(fs), $0.80(mf) OTS
648	17-35961	Dep.(mc); $1.60(fs), $0.80(mf) OTS
653	17-36154	Dep.(mc); $1.10(fs), $0.80(mf) OTS
669	17-35619	Dep.(mc); $1.10(fs), $0.80(mf) OTS
678	17-36876	Dep.(mc); $4.60(fs), $1.55(mf) OTS
679	17-36032	Dep.(mc); $1.60(fs), $0.80(mf) OTS
OTS–	**(Misc.)**	
63-31468*	17-35343	For translation see JPRS-20520
63-31523*	17-35346	For translation see JPRS-20630
63-31570*	17-35602	For translation see JPRS-20713
63-31585*	17-35459	For translation see JPRS-20735
63-31622*	17-36093	For translation see JPRS-20805
63-31650*	17-35438	For translation see JPRS-20864
P–	**(Misc.)**	
2665(RAND)*	17-35258	$1.10(OTS)
PAEC(D)PH–	**(Philippines)**	
634	17-36033	Dep.(mc)
636	17-36034	Dep.(mc)
PAN–	**(Polish)**	
255	17-36629	Dep.
378/I	17-36116	Dep.
379/IX–	17-36753	Dep. Nucl. Fusion, 3: 1-4(1963) (In English)
396/XVIII	17-36118	Dep.
PATENTS	**(British)**	**(3s. 6d. each, U. K. Patent Office)**
931,912	17-36544	
931,930	17-36961	
931,973	17-36273	
931,974	17-36900	
931,997	17-36901	
932,012	17-35970	
932,013	17-35971	
932,014	17-35972	
932,110	17-35973	
932,171	17-36902	
932,178	17-36181	
932,194	17-35974	
932,240	17-36903	
932,264	17-36904	
932,299	17-36741	
932,336	17-36216	
932,387	17-36217	
932,438	17-36905	
932,463	17-36906	
932,464	17-36907	
932,499	17-35975	
932,536	17-36177	
932,574	17-36239	
932,623	17-36908	
932,651	17-35976	
932,769	17-36018	
932,794	17-36909	
932,795	17-35977	
932,796	17-36910	
932,878	17-36911	
932,912	17-35978	
932,954	17-36830	
932,981	17-36218	
934,413	17-36274	
934,455	17-35623	
934,544	17-36219	
934,612	17-36912	
934,656	17-36913	
934,683	17-36914	
934,813	17-35624	
935,000	17-36742	
935,013	17-35861	
935,164	17-36135	
935,258	17-36915	
PATENTS	**(German)**	
1,099,101	17-36889	
1,104,083	17-36066	
1,108,340	17-36890	
1,110,770	17-36980	
1,111,304	17-36632	
1,115,375	17-36065	
1,116,835	17-36891	
1,118,901	17-36892	
1,119,426	17-36888	
PATENTS	**(U. S.)**	**$0.25 each, U. S. Patent Office**
3,102,678	17-35979	
3,102,849	17-35951	
3,102,850	17-36275	
3,102,851	17-36964	

Report No.	Abstract No.	Availability
3,103,475	17-36965	
3,103,853	17-36916	
3,104,295	17-36136	
3,104,345	17-36831	
3,104,502	17-36276	
3,105,026	17-36917	
3,105,030	17-36918	
3,105,035	17-36919	
3,105,036	17-36920	
3,105,037	17-36921	
3,105,052	17-35850	
3,105,189	17-35980	
PG-Report–	**(British)**	
436	17-35631	Dep.; $0.35(BIS); 2s. 6d. (HMSO)
443	17-35632	Dep.
474	17-35633	Dep.
PIBMRI–	**(Non-AEC)**	
929-61	17-36754	$1.10(OTS)
956-61	17-36755	$1.10(OTS)
974-61	17-36756	$1.60(OTS)
1001-62	17-36757	$3.60(OTS)
1058-62	17-36758	$4.60(OTS)
1064-62	17-36578	$3.60(OTS)
1069-62	17-36759	$4.60(OTS)
1073-62	17-36446	$1.60(OTS)
1093-62	17-36760	$1.60(OTS)
PNE–	**(Misc.)**	
108F	17-35962	Dep.; $2.00(OTS)
234P	17-36010	Dep.; $1.00(OTS)
PRL–	**(Non-AEC)**	
9-18	17-36444	See NP-13090
PSW–		
11	17-36017	See CONF-85-1
PT–	**(Misc.)**	
335	17-36447	See RADC-TDR-52-464(Vol.2)
PUC–		
1962-90	17-36661	Dep.(mc); $1.60(fs), $0.80(mf) OTS
R–	**(Misc.)**	
146-5*	17-36371	See AD-291507
RADC-TDR–	**(Misc.)**	
62-464(Vol.2)*	17-36447	$11.50(OTS)
RAE-TN–	**(British)**	
MET-PHYS-361	17-35697	
RHD–	**(Non-AEC)**	
Vol.4, No.8	17-36085	$0.50(GPO)
RIA–	**(Non-AEC)**	
62-4163	17-35869	$0.75(OTS)
SAM-TDR–	**(Non-AEC)**	
63-26	17-35446	
SC–	**(Misc.)**	
4790(RR)	17-36448	Dep.; $0.50(OTS)
SC-DC–		
3041	17-36119	Dep.(mc); $1.10(fs), $0.80(mf) OTS
3135	17-36120	Dep.(mc); $1.60(fs), $0.80(mf) OTS
SCC–		
13	17-36202	See TID-19423
18	17-36349	See TID-19424
SCDC–		
2902	17-35698	See TID-17035
2927	17-36351	See TID-17503
2951	17-36205	See TID-17858
2958	17-35702	See TID-17505
2963	17-35701	See TID-17487
2964	17-36156	See TID-17493
2979	17-35704	See TID-17807
3008	17-36204	See TID-17847
3017	17-36229	See TID-17856
3149	17-35737	See TID-18471
SCR–		
537	17-36485	Phys. Rev., 126: 2033-9(1962)
650	17-36186	SIAM (Soc. Ind. Appl. Math.) Rev., 5: 128-30(1963)
688	17-36350	Dep.(mc); $1.10(fs), $0.80(mf) OTS
STI-DOC–	**(International Atomic Energy Agency)**	
10/17	17-35919	Technical Reports Series No. 17, 1963. $6.00; Sch 126, 36s. stg; NF 24; DM 21(IAEA)
SY–	**(Misc.)**	
5394-R(Vol.I)*	17-36987	
5394-R(Vol.II)*	17-36988	
TAM–	**(Misc.)**	
224*	17-36278	See AD-287159
TID–		
3564(Rev.1)	17-35620	Dep.; $0.75(OTS)
3572	17-36203	Dep.; $2.25(OTS)
3718	17-35259	Dep.; Free(DTI Extension)
3912	17-35447	Dep.; $6.00(OTS)
8200(8th Rev.)	17-36877	Dep.; $0.50(OTS)
14178(Suppl.1)	17-36121	Dep.; $1.25(OTS)
16900	17-35759	J. Phys. Chem., 67: 1206-11(1963)
17035	17-35698	Dep.(mc); $1.10(fs), $0.80(mf) OTS
17329	17-35870	Dep.(mc); $1.60(fs), $0.80(mf) OTS
17418	17-35699	Dep.(mc); $1.10(fs), $0.80(mf) OTS J. Inorg. Nucl. Chem., 25: 1111-13(1963)
17478	17-35700	Dep.(mc); $1.60(fs), $0.80(mf) OTS
17479	17-35599	Dep.(mc); $7.60(fs), $2.36(mf) OTS
17487	17-35701	Dep.(mc); $3.60(fs), $1.31(mf) OTS
17490	17-35448	Dep.(mc); $3.60(fs), $1.13(mf) OTS
17493	17-36156	Dep.(mc); $1.60(fs), $0.80(mf) OTS
17503	17-36351	$1.60(fs), $0.80(mf) OTS
17505	17-35702	Dep.(mc); $3.60(fs), $1.25(mf) OTS
17548	17-36878	Dep.(mc); $2.60(fs), $0.89(mf) OTS
17605	17-35334	Dep.(mc); $5.60(fs), $1.97(mf) OTS
17758	17-36122	Dep.(mc); $1.60(fs), $0.80(mf) OTS
17785	17-36662	Dep.(mc); $1.10(fs), $0.80(mf) OTS
17786	17-35703	Dep.(mc); $1.10(fs), $0.80(mf) OTS
17798	17-35621	Dep.(mc); $2.60(fs), $0.95(mf) OTS
17807	17-35704	Dep.(mc); $2.60(fs), $0.86(mf) OTS
17847	17-36204	Dep.(mc); $1.60(fs), $0.80(mf) OTS
17851	17-35335	Dep.(mc); $3.60(fs), $1.13(mf) OTS
17854	17-35989	Dep.(mc); $2.60(fs), $0.86(mf) OTS
17856	17-36229	$7.60(fs), $2.39(mf) OTS
17857	17-36035	Dep.(mc); $1.10(fs), $0.80(mf) OTS
17858	17-36205	Dep.(mc); $3.60(fs), $1.13(mf) OTS
17866	17-36123	Dep.(mc); $1.60(fs), $0.80(mf) OTS
17867	17-36302	Dep.(mc); $1.60(fs), $0.80(mf) OTS
17868	17-36579	Dep.(mc); $1.10(fs), $0.80(mf) OTS
17870	17-35449	Dep.(mc); $2.60(fs), $0.83(mf) OTS
17871	17-36630	Dep.(mc); $1.10(fs), $0.80(mf) OTS
17882	17-35450	Dep.(mc); $2.60(fs), $0.83(mf) OTS
17914	17-36303	Dep.(mc); $2.60(fs), $1.01(mf) OTS

Report No.	Abstract No.	Availability
		Trans. Am. Soc. Metals, 56: 442-54 (1963)
17965	17-35406	Dep.(mc); $1.10(fs), $0.80(mf) OTS
17974	17-36230	Dep.(mc); $1.60(fs), $0.80(mf) OTS
17977	17-35437	Dep.(mc); $5.60(fs), $1.76(mf) OTS
17979	17-36580	Dep.(mc); $3.60(fs), $1.16(mf) OTS
17981	17-35451	Dep.(mc); $1.60(fs), $0.80(mf) OTS
17986	17-36449	$11.50(fs), $4.94(mf) OTS
18471	17-35737	J. Chem. Phys., 39: 1183-6(1963)
18621	17-35744	J. Chem. Phys., 39: 1360-1(1963)
19005	17-36607	Phys. Rev., 131: 2704-9(1963)
19037	17-36707	Phys. Rev., 131: 2649-63(1963)
19094	17-35634	Dep.(mc); $2.60(fs), $0.86(mf) OTS
19135	17-35260	Dep.(mc); $21.00(fs), $9.69(mf) OTS
19164	17-36993	Dep.(mc); $6.60(fs), $2.27(mf) OTS
19186	17-36994	Dep.(mc); $1.10(fs), $0.80(mf) OTS
19187	17-36995	Dep.(mc); $8.60(fs), $2.93(mf) OTS
19188	17-36996	Dep.(mc); $1.60(fs), $0.80(mf) OTS
19189	17-36997	Dep.(mc), $5.60(fs), $1.94(mf) OTS
19220	17-35871	Dep.(mc); $1.10(fs), $0.80(mf) OTS
19260	17-35808	Science, 141: 1039-40(1963)
19267	17-36930	Dep.; $3.50(OTS)
19274	17-35452	Dep.(mc); $1.60(fs), $0.80(mf) OTS
19275	17-36450	Dep.(mc); $1.10(fs), $0.80(mf) OTS
19276	17-35705	Dep.(mc); $1.60(fs), $0.80(mf) OTS
19287	17-35453	Dep.(mc); $1.10(fs), $0.80(mf) OTS
19291	17-35454	Dep.(mc); $2.60(fs), $0.98(mf) OTS
19293	17-35600	$1.10(fs), $0.80(mf) OTS
19296	17-36451	Dep.(mc); $9.10(fs), $3.44(mf) OTS
19297	17-36036	Dep.(mc); $1.10(fs), $0.80(mf) OTS
19302	17-35455	Dep.(mc); $1.10(fs), $0.80(mf) OTS
19303	17-36452	Dep.(mc); $3.60(fs), $1.16(mf) OTS
19307	17-35706	Dep.(mc); $1.60(fs), $0.80(mf) OTS
19310	17-36453	Dep.(mc); $4.60(fs), $1.55(mf) OTS
19318	17-35261	Dep.(mc); $2.60(fs), $0.86(mf) OTS
19324	17-35601	Dep.(mc); $4.60(fs), $1.58(mf) OTS
19326	17-35990	Dep.(mc); $1.60(fs), $0.80(mf) OTS
19327	17-35456	Dep.(mc); $5.60(fs), $1.94(mf) OTS
19329	17-36663	Dep.(mc); $4.60(fs), $1.52(mf) OTS
19331	17-36581	Dep.(mc); $2.60(fs), $0.89(mf) OTS
19332	17-35407	Dep.(mc); $3.60(fs), $1.25(mf) OTS
19336	17-36582	Dep.(mc); $8.60(fs), $2.99(mf) OTS
19337	17-36304	Dep.(mc); $1.10(fs), $0.80(mf) OTS
19342	17-36583	Dep.(mc); $1.60(fs), $0.80(mf) OTS
19343	17-36584	Dep.(mc); $6.60(fs), $2.18(mf) OTS
19345	17-35457	Dep.(mc); $2.60(fs), $0.98(mf) OTS
19348	17-36454	Dep.(mc); $1.10(fs), $0.80(mf) OTS
19359	17-35622	Dep.(mc); $2.60(fs), $1.04(mf) OTS
19361	17-35635	Dep.(mc); $1.60(fs), $0.80(mf) OTS
19364	17-35963	Dep.(mc); $1.10(fs), $0.80(mf) OTS
19365	17-36037	Dep.(mc); $3.60(fs), $1.19(mf) OTS
19423	17-36202	Dep.(mc); $2.60(fs), $0.92(mf) OTS
19424	17-36349	Dep.(mc); 3.60(fs), $1.31(mf) OTS
TM–	**(Misc.)**	
62-9-8	17-36243	See CONF-53-8
63-7-12	17-35677	See CONF-39-87
3544-67*	17-36188	See AD-289857
TN–	**(Non-AEC)**	
469	17-36832	See AD-291133
TO-B–	**(Non-AEC)**	
61-34	17-36038	
TRG-Inf. Ser.–	**(Non-AEC)**	
306	17-35993	Dep.; $1.60(fs), $0.80(mf) JCL or OTS
TRG-Report–	**(Non-AEC)**	
434	17-36585	Dep.; $0.35(BIS); 2s. 6d. (HMSO)
474	17-36879	Dep.; $0.70(BIS); 5s. (HMSO)
573	17-36834	Dep.; $0.42(BIS); 3s. (HMSO)

Report No.	Abstract No.	Availability
TRW-ER–	**(Misc.)**	
5464*	17-36455	
UAC–		
6597	17-35759	See TID-16900
6830	17-35599	See TID-17479
6883	17-35699	See TID-17418
6891	17-35448	See TID-17490
6926	17-35703	See TID-17786
6969	17-35334	See TID-17605
6982	17-36662	See TID-17785
7021	17-36123	See TID-17866
7033	17-36579	See TID-17868
7043	17-35989	See TID-17854
7050	17-36035	See TID-17857
7060	17-35449	See TID-17870
7061	17-36630	See TID-17871
7075	17-35335	See TID-17851
7085	17-36302	See TID-17867
7745	17-36570	See CONF-122-9
UAG-R–	**(Non-AEC)**	
127(Pt.I)	17-36561	
127(Pt.II)	17-36562	
UCLA–		
515	17-35336	Dep.(mc); $8.10(fs), $2.81(mf) OTS
UCRL–		
6989	17-36664	Dep.; $0.50(OTS)
7191	17-35964	Dep.; $1.00(OTS)
7199-T	17-36466	Appl. Opt., 2: 707-13(1963)
7237	17-35362	Cancer Res., 23: 1059-62(1963)
7276	17-36124	Dep.(mc); $1.60(fs), $0.80(mf) OTS
7319-T	17-35805	Phys. Chem. Solids, 24: 1066(1963)
7343-T	17-35707	Dep.(mc); $1.10(fs), $0.80(mf) OTS
7355	17-36039	Dep.; $1.00(OTS)
7363	17-36761	Dep.; $0.50(OTS)
7374	17-36989	Dep.(mc); $5.60(fs), $1.73(mf) OTS
7376	17-36665	Dep.; $0.75(OTS)
7401	17-35965	Dep.; $0.50(OTS)
7441	17-36880	Dep.(mc); $1.60(fs), $0.80(mf) OTS
10099(Rev.)	17-36666	Dep.(mc); $3.60(fs), $1.28(mf) OTS
10484	17-36667	Dep.(mc); $1.60(fs), $0.80(mf) OTS
10506	17-36704	Phys. Rev., 131: 2617-24(1963)
10621	17-36608	Phys. Rev., 131: 2713-18(1963)
10706	17-35262	Dep.; $3.00(OTS)
10712	17-36206	Dep.(mc); $4.60(fs), $1.64(mf) OTS
10763	17-35741	J. Chem. Phys., 39: 1349-51(1963)
10776	17-36857	Phys. Rev., 131: 2820-6(1963)
10793	17-36306	Dep.; $1.00(OTS)
10803	17-35708	Dep.(mc); $1.60(fs), $0.80(mf) OTS
10804	17-35709	Dep.(mc); $1.60(fs), $0.80(mf) OTS
10813	17-36586	Dep.; $2.25(OTS)
10849	17-36762	Dep.; $2.50(OTS)
10864	17-36587	Dep.; $1.25(OTS)
10878	17-36456	Dep.; $1.75(OTS)
10888	17-36668	Dep.; $0.75(OTS)
10891	17-36457	Dep.(mc); $1.60(fs), $0.80(mf) OTS
UJV–	**(Czechoslovakian)**	
528	17-35710	
873/62	17-35939	Dep.(mc)
951/63	17-35940	Dep.(mc)
952	17-35872	Dep.(mc)
USAERADL-TR–		**(Non-AEC)**
2292	17-36352	$6.60(OTS)
WAPD–	**(Misc.)**	
245	17-36254	Dep.; $2.50(OTS)

Report No.	Abstract No.	Availability
270	17-36305	Dep.; $0.50(OTS)
WAPD-MRP-		
93	17-36931	Dep.; $2.50(OTS)
104	17-36932	Dep.; $2.50(OTS)
WAPD-PWR-		
1606(Add.1)	17-36933	Dep.; $1.50(OTS)
WAPD-TM-	**(Misc.)**	
302	17-35991	Dep.; $1.00(OTS)
326	17-36934	Dep.; $0.75(OTS)
351	17-36353	Dep.; $1.25(OTS)
WASH-		
1042	17-36669	Dep.; $1.25(OTS)
WCAP-	**(Misc.)**	
2346	17-36155	Dep.(mc); $1.60(fs), $0.80(mf) OTS